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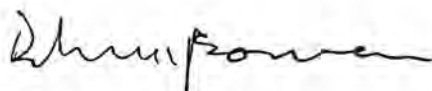
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ABSTRACT

Title of Dissertation: An Examination of Possible Explanations for Differential Weight Changes Associated with Pregnancy

Deborah J. Bowen, Doctor of Philosophy, 1986

Dissertation directed by: Neil E. Grunberg, Ph.D.
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Pregnancy is a time in adult life when weight gains are considered a sign of health. The recommended weight gain for women in the United States is 25 pounds. Some women, however, gain differential amounts of weight during their pregnancies. Reasons for this differential gain are unknown. Two studies were designed to examine several explanations for differential weight gains suggested in the literature. A human laboratory study of 50 women (38 pregnant and 12 postpartum) was designed to investigate behavioral and psychological variables during all three trimesters and a postpartum period. This study was presented to subjects as a taste perception study to avoid self-consciousness about eating. Food from three taste classes--sweet, salty, and bland--was provided to subjects. Consumption of food from each class, as well as general laboratory food consumption, was measured. Psychological measures, such as restraint, affect, social support, and stress questionnaires, were given to each subject. Women in the second trimester consumed more sweet-tasting food and more calories than did women in any other study period. No subject in the present study gained excess weight, possibly because all subjects were restrained eaters.

To avoid psychological influences such as restraint, an animal study using 48 female rats in 4 groups of 12 was conducted to measure behavioral and biological variables longitudinally across pregnancy. The design crossed pregnancy with type of food available. Body weight and adipocyte number and size, and consumption of laboratory chow, glucose solution, and water were measured daily before, during, and after pregnancy. Pregnant and postpartum rats, with access to both glucose solution and chow, had more adipose tissue than did both non-pregnant controls and pregnant controls provided with only laboratory chow. Pregnant and postpartum rats consumed more glucose solution than did both groups of controls. The results of both studies show that sweet food consumption changes could affect weight gains associated with pregnancy. The results of the human study also suggest that psychological factors, such as restraint, could be involved in the attenuation of any excessive gains during and after pregnancy.

AN EXAMINATION OF POSSIBLE EXPLANATIONS FOR
DIFFERENTIAL WEIGHT CHANGES ASSOCIATED WITH PREGNANCY

by

Deborah J. Bowen

Dissertation submitted to the Faculty of the Department of Medical
Psychology Graduate Program of the Uniformed Services
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fulfillment of the requirements for the
degree of Doctor of Philosophy 1986

To Neil Grunberg for a hero

and

to Helen Boscoe for being there.

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INTRODUCTION

Pregnancy is a particular time in adult life when weight gains are considered to be a sign of health. During the course of normal pregnancy, a woman gains an average of 20-25 pounds. Yet some pregnant women gain as much as 80 pounds and remain obese after delivery of their infants (Kawakami, Ishiwata, Hayashi, Kawaguchi, Kondo, & Iizuka, 1977; Niswander and Gordon, 1972). Excessive weight gain has negative implications for both maternal and fetal health. In addition, excessive weight increases can leave the mother weighing 10-20 lbs. more after delivery than before her pregnancy. Unfortunately, little is known about what factors contribute to excessive weight gain during pregnancy.

Weight Gains During Pregnancy

Not much is known about the reasons for differential weight gains associated with pregnancy. Physicians' advice to pregnant women concerning their weight gains has fluctuated over the years (Hyttén, 1981). In the 1940's and 1950's physicians recommended that a pregnant woman restrict her diet to avoid excessive weight gains; 14 kg (roughly 30 pounds) was the maximum recommended gain. During the 1960's and early 1970's some doctors in the U. S. and in Britain took a strikingly different approach and encouraged pregnant women to eat as much as they desired. More recently, the American College of Obstetrics and Gynecology has recommended that women gain 5 pounds before the first trimester of pregnancy and a pound a week until delivery, or a total of 25 pounds during the entire pregnancy. If women gain weight more rapidly, physicians counsel them to monitor their food intake to prevent excessive weight gain (Alpers, Clouse, & Stenson, 1984).

Not only is weight gain during pregnancy a positive sign, but adequate weight gains are necessary to insure the health of both mother and child. Specific patterns of weight gain have been identified over the course of pregnancy (Niswander & Gordon, 1972). For example, weight gains in the first trimester are generally low. Any weight gains during the second trimester are usually in the maternal compartments (e.g., subcutaneous maternal adipose tissue, blood volume increases, or placental growth). Third trimester weight gains result from increased fetal size and development. Factors to consider in assessing optimal weight gain for an individual woman are the quality of the weight increase (i.e., adipose tissue versus water retention) and prepregnancy weight level as well as absolute amounts or rates of gain. Nutritional and caloric intake as related to adequate weight gains during pregnancy have been the focus of much research, especially in undernourished populations (Naismith, 1980). Adequate protein, vitamins, and minerals are as important as simple caloric intake. Depending on prepregnancy nutritional status, the mother's diet may need to be supplemented with extra protein and specific nutrients.

If excessive weight gains do occur during or after pregnancy, they could lead to obesity. Obesity, or excessive body fat, is an important and pervasive problem in the United States (Grunberg, 1982a; Powers, 1980; Stunkard, 1980). Estimates of the number of obese people in the adult population range from 10 percent to 35 percent, depending on age, sex, and socioeconomic status (Bray, 1980). Obesity is associated, either directly or indirectly, with a variety of diseases, including diabetes, hypertension, menstrual and reproductive abnormalities, arthritis, gout, atherosclerosis, abnormal heart size and function, and

gallbladder disease (Rimm & White, 1979). In addition, the psychological problems that may result from obesity are numerous: anxiety, negative self-perception, disturbed body image, and discrimination in the job market. Women are particularly susceptible to the psychological ramifications of excess weight gain (Rodin, Silberstein, and Striegel-Moore, 1984). Although a recent National Institutes of Health Consensus Conference illustrated the controversy that currently exists as to the exact level of obesity at which health risks appear, most scholars agree that in general moderate obesity poses health risks for an individual (National Institutes of Health, 1985). Therefore, someone who gains excessive amounts of weight during pregnancy faces a range of psychological and physiological health hazards, particularly if this excess weight is not lost after delivery.

For many possible reasons women are at risk of gaining excess weight associated with pregnancy (Woods, Dewar, Malan, Heese, & Rush, 1980). Not all pregnant women, however, experience excessive weight gains at these times. Estimates of numbers of women who gain excessive weight (above the recommended 25 pounds) range from 10 percent to 40 percent (Woods, et al., 1980). The relationship between prepregnancy maternal obesity levels and weight gain during pregnancy is unknown. Possibly, women who are obese before becoming pregnant gain more weight than do normal-weight women. Obese women could, however, gain similar amounts of weight or even less weight than could normal-weight women. Any of these hypotheses are possible.

There are several variables that predict excessive gains. For instance, there is a positive linear relationship between number of previous pregnancies (parity) and amount of weight gained during the

next pregnancy (Heliovaara & Aromaa, 1981), a finding not statistically related to age of the mother. This weight is less likely to be lost after delivery with each successive pregnancy (Beazley & Swinhoe, 1979). The same relationship between parity and pregnancy-associated weight gain is present in animal models (Eisen, 1977; Holinka, 1980).

A demographic variable associated with excessive weight gains during pregnancy is socioeconomic level. Women of lower socioeconomic levels are more likely to gain excessive pregnancy-associated weight than are women of upper socioeconomic levels (Newcombe, 1982). Therefore, cultural factors may be involved in the excessive gains.

Another fact that may help explain excessive weight gains with pregnancy is that nonsmokers gain more weight during pregnancy and are less likely to lose excess weight than are smokers (Garn, Shaw, and McCabe, 1980). Possibly, the same physiological and psychological changes that cause smokers to weigh less than comparably aged nonsmokers (e.g., specific food consumption, metabolic changes) may keep pregnant women who smoke from getting fat (Grunberg, 1985; Grunberg, Bowen, Maycock, & Nespor, 1985; Wack & Rodin, 1982). These studies suggest who will gain excessive amounts of weight during pregnancy, but they do not explain the reasons for it.

Women who gain excessive weight during or after their pregnancies are gaining the weight in the maternal compartments and not in the fetoplacental units (Holinka, 1980). Gains of 15-20 kg--gains well beyond the current recommended 25 pounds (11 kg)--are not uncommon. If an average woman weighs 50 kg, this 11 kg gain is 20-30 percent of prepregnancy weight. Most of the excessive weight gain associated with pregnancy is in the form of subcutaneous body fat and is not simply

water retention (Hytten, 1981; Woods et al., 1980). Therefore, it is not lost during the delivery process. Because excess body fat gains during pregnancy are not lost during the immediate postpartum period (as are excess water retention, placental gains, etc.), women could develop obesity that may be both physiologically and psychologically detrimental.

Besides the harmful effects of obesity in general, excessive weight gains associated with pregnancy have specific effects related to maternal and infant well-being. Incidence of three major obstetrical complications--pre-eclampsia, premature births, and prenatal deaths--are lowest when rate of weight gain is approximately 450 g/week (Hytten, 1981). Faster rates of weight gains are associated with increased rates of these complications (Naeye, 1979). Luke & Petrie (1980) reported that underweight and obese mothers had babies of low birth weight, a condition associated with neonatal mortality and morbidity. Mice with average body weight gains during pregnancy had the lowest pre- and post-implantation embryonic mortality rates (Durrant, Eisen, & Ulberg, 1980), as compared with mice of either low or high gains. Considering these studies together, excessive weight gains associated with pregnancy can have deleterious effects on both mother and child.

Possible Explanations for Pregnancy-Associated Weight Gain

Theoretically, a woman should gain 20-25 pounds during the course of her pregnancy and lose almost all of that weight soon after delivery. Yet frequently women with similar nutritional backgrounds gain different amounts of weight during and after their pregnancies. Several proposed explanations for differences in maternal weight gains

during pregnancy are found in the obesity literature. These explanations can be grouped into three major categories: behavioral, psychological, and biological. An example of a behavioral change that could increase body weight is increased general food consumption. Some women could eat more than others, and so gain weight. Another behavioral change that may also account for the weight gains during or after pregnancy is a change in consumption of specific foods (rather than of all foods). Psychological changes that could be involved in the differential body weight gains associated with pregnancy include depression, anxiety, and general emotional upset. A biological explanation for the excess weight gains is that women who gain excess weight may be metabolically different from their normal-weight counterparts, and so would gain more weight during or after pregnancy. It is possible that differences that cause normal weight gains associated with pregnancy could play a role in excessive gains as well. Explanations for these changes are examined in the next sections.

Behavioral Explanations

General food consumption changes. One of the simplest explanations is that some women eat more than they require for maternal and fetal needs during or after pregnancy and so gain weight (Picone, Allen, Schramm, & Olsen, 1982). It has been well-documented in animals (Strubbe & Gorrisen, 1980) and in humans (Naismith, 1980) that food consumption increases steadily throughout pregnancy, and that by the third trimester the mother has an increased layer of subcutaneous fat stored to meet the caloric drain incurred while nursing her infant (Newcombe, 1982). In some cases the notion of "eating for two" may be taken to extremes

during pregnancy and the excess caloric intake would result in obesity during pregnancy.

General food consumption in relation to these excessive weight gains has not been well studied. Most of the dietary monitoring of pregnant humans and animals has focused on protein requirements of undernourished mothers and has not gathered the requisite data for determining whether general food consumption contributes to excessive body weight (see Zlatnik, 1979, for a review of undernourishment and pregnancy). Few studies have measured dietary intake in well-nourished women (Naismith, 1980; Zlatnik, 1979), and none have related food consumption changes to any excessive body weight gains throughout pregnancy (Dobbing, 1981). Hitier, Champigny, Homayoon, and Bourdell (1982) monitored laboratory consumption and body weight before, during, and after pregnancy in rats. They found that food consumption increases paralleled body weight increases throughout pregnancy, but they made no attempt to relate individual differences in weight gain to differences in food consumption. In addition, they did not measure body fat or perform any analysis that examined the amount of weight gained in the maternal compartments in particular. Based on the limited research literature, the possibility still exists that differences in total caloric intake due to changes in general food consumption could contribute to excessive weight gains during and after pregnancy. A careful examination of food intake is necessary to relate excess food consumption to excess body fat gains during and after pregnancy. If general food consumption does not contribute to excess weight gains associated with pregnancy, then other factors, discussed below, must be involved.

Specific food consumption changes. An explanation for weight gains associated with pregnancy based on both research and folklore is that specific food aversions and cravings influence caloric intake and thereby modify body weight. According to popular beliefs, pregnant women crave pickles and ice cream. The presence of cravings and aversions associated with pregnancy is substantiated by a few reports in the literature (Brewin, 1980; Hook, 1978, 1980; Schulman, 1984). Hook (1978) interviewed 250 pregnant women about their eating habit changes, food cravings, and food aversions during their pregnancies. He attributed the vast majority of the reported cravings and aversions to metabolic needs and changes experienced throughout the pregnancy. Women in his sample commonly reported a craving for milk or dairy products. Hook (1978) hypothesized that this craving was due to a high need for calcium during pregnancy. According to Hook any change in physiological need during the pregnancy could induce a craving for some food or type of food that could satisfy the need. Although Hook had no data directly relating metabolic changes to cravings for particular foods, it is possible that cravings are caused by physiological needs not met by a regular diet.

In contrast, Schulman's (1984) data support the idea that cravings and aversions are caused by associations with onset and recovery from the nausea of morning sickness. Animals that consume food just prior to the injection of a gastrointestinal irritant will develop an aversion to that specific food (Garcia & Koelling, 1966). If a different diet is presented simultaneously with recovery from nausea, animals show a preference for the new diet (Garcia, Ervin, Yorke, & Koelling, 1967). Also, if a diet is deficient in a particular needed nutrient,

then animals will learn to avoid that diet (Rozin & Kalat, 1971). Schulman (1984) proposed that cravings and aversions during pregnancy developed for similar reasons. According to Schulman, women who report nausea during their pregnancies will experience more cravings and aversions than those women who do not report nausea. Schulman also predicted that aversions will develop before cravings because aversions should coincide with the onset of nausea and cravings with recovery from nausea. He administered questionnaires to women in the third trimester of pregnancy to assess the extent of their nausea, cravings, and aversions during pregnancy. He found that aversions did occur before cravings and that women who reported nausea were more likely to report taste preference changes. Basically, his data support his hypotheses. Unfortunately, the design of the study, using retrospective dietary recall at a single point in pregnancy, was not optimal. No firm conclusions can be drawn about the course of the taste preference changes relative to the nausea experienced during pregnancy. Regardless of the causes of these taste preference changes, it seems that some women do acquire cravings and aversions during their pregnancies that might influence later food intake.

The extent to which cravings and aversions could influence caloric intake and body weight gains associated with pregnancy is not known; body weight, body fat, and general food intake were not measured in these studies. It follows from Schulman's data that if women have nausea during pregnancy they will have more aversions and cravings. If they experience a craving for a food or type of food that is high in calories (e.g., ice cream or pasta), then they would consume more of this food and gain weight during their pregnancy provided that they did

not develop an aversion to other foods of equal caloric value and so decrease their consumption of these aversive foods. Hook's hypothesis of metabolic changes influencing specific food consumption would predict that differences in metabolic need between women could cause differences in consumption of specific types of food. Differences in consumption of specific foods that are also high in calories could lead to excess body weight gains.

Drawing from another body of literature, there is empirical evidence that changes in taste preference and specific food consumption can affect body weight. Recent studies (Grunberg, 1982b; Grunberg, Bowen, Maycock, & Nespor, 1985) have shown that changes in preference for sweet-tasting foods during and after nicotine administration contribute to changes in body weight. Smokers in withdrawal from cigarettes show an increased preference for sweet-tasting, high caloric foods, and gain weight after they quit smoking. One reason proposed to explain this sweet food preference change is a change in the rate of energy utilization (Grunberg, 1985). If this hypothesis is correct, then changes of other types (besides smoking cessation) that affect the way the body processes nutrients could lead to changes in preferences for sweet-tasting, high caloric foods and thereby result in changes in body weight. Pregnancy-associated changes in energy utilization rates might alter body weight via this type of mechanism (see section in this paper on "Energy utilization" for a more complete explanation of changes associated with pregnancy).

The causes of metabolic differences among women that might account for changes in taste preferences have not been studied. Recent evidence indicates that the most important demographic factor in whether

or not a woman will gain weight after smoking cessation is previous weight history. Indeed, people who gain weight, lose it, and gain weight again find it more difficult to lose the same weight the second time (Brownell, 1983). The relationships between weight history, energy utilization, and changes in taste preference that might account for excessive weight gains have not been studied in pregnant women or even in the general population. Possibly, some women, because of previous weight fluctuations, previous pregnancies, or other variables, are different from others in the way that they use or store energy. These physiological differences between pregnant women could cause food preference changes that would result in changes in body weight.

There is indirect evidence for the idea that physiological differences during pregnancy might lead to changes in taste preference and excessive weight gains. Hook (1980) found that, in general, preference for sweet-tasting foods increased during pregnancy, an increase that he believes to be caused by changing metabolic need during pregnancy. Regardless of the reasons for the change, some women might have a greater change in specific food consumption than others. The possibility exists that craving for a particular food or type of food could influence caloric intake and thereby affect weight gains either during or after pregnancy. Possibly, taste preference changes are involved with excess body weight changes associated with pregnancy. Changes in taste preference need to be measured throughout the course of pregnancy and related to any body weight gains.

Psychological Explanations

Affect. Emotional changes, such as depression and anxiety, are a part of the experience of pregnancy for some women (Carnes, 1983; Cox,

Conner, & Kendall, 1982; Kumar & Robsan, 1984; True-Soderman, Buckwalter, & Kerfoot, 1982). Changes in emotion that occur during pregnancy include increases in anxiety and depression (Fagley, Miller, & Sullivan, 1982; Scott-Heyes, 1982), hostility (Little, Hayworth, Benson, Bridge, Dewhurst, & Priest, 1982), and general emotional distress (Norbeck & Tilden, 1983; Tilden, 1983). Although critics have questioned the notion of specific emotional patterns associated with pregnancy for all women (Lips, 1982; Stern & Kruchman, 1983), at least for some women there seem to be many types of measurable emotion changes during and/or after pregnancy.

Most of the research documenting affective changes has focused on the postpartum period. Estimates of percentages of women experiencing depression either during or after pregnancy can range from 4 percent (Garvey & Tollefson, 1984) to almost 50 percent (Lee, 1982). Recently, Hopkins, Marcus, and Campbell (1984) have divided postpartum affective disorders into three categories: (1) the "maternity blues," a common, mild disturbance occurring immediately after giving birth and lasting 24-28 hours; (2) postpartum affective psychosis, a rare psychotic episode that is similar to non-pregnancy psychosis; and (3) moderate to mild postpartum depression, an affective change that is relatively common--estimates run from 10-25 percent in a normal population of women and can occur up to three months after delivery. Hopkins et al. (1984) believe that postpartum depression (the third category) is the most important of the three disturbances because the occurrence of postpartum depression has clear, long-lasting detrimental effects on both mother and child, and because postpartum depression is a relatively common affective disorder.

The development of postpartum depression has been linked to a number of different variables. Environmental events can play a role in the etiology of depression. For example, incidence of obstetric and childcare stressors (O'Hara, Nennaber, & Zezoski, 1984) and decreases in spouse social support (O'Hara, Rehm, & Campbell, 1983) were positively related to incidence of postpartum depression in a sample of normal women. Biological changes also can be important. For instance, increases in plasma levels of endogenous hormones, such as prolactin (Mastrogiacomo, Fava, Fava, Kellner, Grismondi, & Cetera, 1982-3) and catecholamines (Kuevi, Canson, Dixson, Everand, Hall, Hole, Whiteshead, Wilson, & Wise, 1983) were correlated with incidence of postpartum depression. In addition, cognitive and behavioral factors, such as attributional style and coping mechanisms, are involved in the development of postpartum depression (Cutrona, 1983; O'Hara, Rehm, and Campbell, 1982). Presence of several factors, such as past pathological psychiatric history, high incidence of obstetrical difficulties, and previous menstrual distress, also play a role in the etiology of postpartum depression (Kerfoot & Buckwalter, 1983). Regardless of the factors causing it, depression is a real phenomenon that could occur either during or after pregnancy.

These emotional changes during both pregnancy and the postpartum period could be related to excessive body weight gains. Increases in depression and anxiety have been associated with increased body weight. For example, weight changes are a common symptom of clinical depression (American Psychiatric Association, 1980). Also, obesity and emotionality have been related in social psychological laboratory

studies (Schachter, 1971; Schachter & Rodin, 1974). Spitzer & Rodin (1981) wrote that although no clear explanations exist, changes in affect can lead to increases in food consumption and obesity, and that more research is needed to determine possible mechanisms for the emotion/arousal/eating relationship. Possibly, those women who gain excessive amounts of weight during or after their pregnancies are experiencing more severe changes in emotion. If some women, because of environmental or psychological events, develop higher levels of depression or anxiety than do others during or after their pregnancies, they might eat more and become obese.

No studies have concurrently assessed emotional changes, energy intake, and body weight changes associated with pregnancy. It is reasonable to predict a relationship between emotional experiences and body weight changes during and after pregnancy. This possibility deserves research attention.

Restrained eating. Restrained eating is defined as the cognitive control of eating behavior (Stunkard & Messick, 1985). Restrained eaters are people who usually eat less than they actually want, unless their restraints are lifted. Then, they consume more than their usual amount of food and eat more than do normally unrestrained eaters (Herman & Polivy, 1980). The lifting of restraint, or disinhibition, of normally restrained eaters can result from many variables: alcohol consumption, forced caloric preload, experimentally induced anxiety, and clinical depression (Herman & Polivy, 1980). According to Herman and Polivy, any major disruption or stressor might be enough to disinhibit normally restrained eaters and might cause them to consume calories in excess of

nutritional needs. Consumption of excess calories over a period of weeks or months will result in weight gains.

To the extent that the experience of pregnancy could serve as a source of stress for some women, previously restrained eaters could lose their restraint during or after pregnancy, consume more calories than they need, and gain excess weight. The source of stress could be either the experience of pregnancy itself (e.g., "This pregnancy makes me feel fat and unattractive.") or a factor related to the pregnancy (e.g., "This pregnancy is expensive, and I will have a difficult time making ends meet."). Pregnancy could also legitimize a lifting of restraint (e.g., "I must consume more calories because my developing child needs nutrients."). Regardless of the cause of the disinhibition, the lifting of restraint during or after pregnancy should cause previously restrained women to consume excess calories. Women who score higher on scales designed to measure restraint (Herman & Polivy, 1980; Stunkard & Messick, 1985) and who experience pregnancy as stressful, could gain more weight than other women. This possibility has not been examined but seems likely.

Biological Explanations

Energy utilization. Another explanation for the increased weight gains associated with pregnancy is a change in metabolism, or the way in which the body processes nutrients. In a normal state, ingestion of nutrients is followed by an increase in plasma insulin. Insulin promotes the storage of available nutrients into muscle and adipose tissue. It is well-established that the third trimester of pregnancy is accompanied by an insulin-resistant state (Hornnes & Kuhl, 1980). In other words, a given glucose load will produce a higher corresponding plasma

insulin increase late in pregnancy. More insulin is needed to perform the same physiological function. This increased insulin resistance is believed to be caused by a decrease in insulin receptor number and efficiency (how effectively insulin binds) on adipose tissue (Pagano, et al., 1980).

Not all women, however, experience the same changes in metabolism over the course of pregnancy. Insulin receptor number is decreased, leading to an even higher resistance (above that of normal pregnancy) to the effects of insulin, in women who gain excessive weight during pregnancy (Toyoda, 1982), suggesting that these women may be metabolically different from their counterparts who show normal weight gains. Unfortunately, Toyoda (1982) did not control for prepregnancy metabolic functioning. One explanation for these results is that women who gain excess weight during pregnancy are biologically predisposed, or "primed" to gain excess weight. Pregnancy, then, would act as a stimulus for excess weight gains. An alternative explanation is that some women gain excess weight and, as a result of the increase in weight, become more insulin-resistant than women who do not have excess weight gains. Either explanation is possible. If the first explanation is true, some women are metabolically different from others before pregnancy, and will gain excess weight during pregnancy without a psychological or a behavioral change.

Multiple factors have been identified as possible causes of the normal increased tissue resistance to insulin during pregnancy (see Fuchs & Klopfer, 1983, for a review of this and other endocrinological changes during and after pregnancy). One of the main factors is the

steady increase in levels of ovarian and placental steroids, specifically estrogens and progestins, that accompany normal pregnancy.

Estrogens and progestins have been shown to regulate body weight, food consumption, and carbohydrate and lipid metabolism in normally cycling female humans and rats (Pliner & Fleming, 1983; Wade, 1979). Estrogens and progestins modulate body weight and food consumption during and after pregnancy (Czaja, 1983; Rands, Newhouse, Stewart, & Bradshaw, 1982; Weisenbaum, Kenney, & Adler, 1979). Increased levels of estrogen alone decrease body weight, food consumption, and metabolism, while concurrent rises in estrogens and progestins cause increases in these three variables (Wade, 1979). These hormones are important in the control of body weight and food consumption in the intact normal organism.

Because estrogens and progestins play a major role in normal metabolic regulation, these hormones might be involved in any metabolic changes that could cause excess weight gains. Possibly, individual differences in either levels of estrogens and progestins or in tissue sensitivity to these hormones might account for the changed insulin resistance and thereby effect excessive weight gains associated with pregnancy. Biological differences that might account for the excess weight gains of some women need to be studied and related to body weight changes during and after pregnancy.

Lactation. In the United States today, approximately 25-35 percent of women breast feed their infants (World Health Organization, 1981). This percentage varies as a function of socioeconomic status, advice from obstetricians, and area of the country. The postpartum

period is characterized by a shift from energy storage to energy mobilization to meet the caloric drain of breast feeding not met by dietary intake (Quandt, 1983). Prolactin (one of the major hormones elevated throughout lactation in animals and humans) has been implicated as a major factor that affects food consumption and body weight regulation during and after pregnancy in hamsters (Fleming, 1978). Prolactin is also elevated in nursing humans. Lactating rats lose more weight and body fat than do rats that are not allowed to lactate after their pregnancies (Steingrimsdottir, Brasel, & Greenwood, 1980). Steingrimsdottir et al. (1980) proposed that lactation protects the mother from obesity because the excess weight gains during pregnancy are lost during breast feeding because of the high caloric drain of milk production.

The hypothesis that lactation helps women lose weight seems reasonable and has never been tested in humans. Recently, researchers have discussed the possibility that breast feeding may be psychologically beneficial for the infant and mother. For example, breast feeding may strengthen the initial mother-infant attachment that is crucial to later development. Breast feeding also may benefit the mother by causing her to lose weight. The hormonal and metabolic changes accompanying lactation may be beneficial for the mother in that they may assist her in losing any excess fat stored during pregnancy (Williamson, Agius, Munday, & Robinson, 1983). Women who do not breast feed may be at higher risk for the retention of pregnancy-associated excess weight gains than women who do.

General Overview

Currently there is no single best explanation for the differential weight gains associated with pregnancy. Few studies have directly

assessed any of the variables that might play a role in these differential gains. Weight and/or body fat differences have not been related to changes in either general or specific food consumption, and so this relationship remains unexplored. Psychological changes have not been examined concurrently with any excessive weight gains during and after pregnancy. No research has examined metabolic changes throughout the course of pregnancy that might explain the weight gains of some women. The role of metabolism in the excess pregnancy-associated weight gains is still unclear. Studies are needed that link excessive weight gains to factors that might be causing them.

The few studies that have examined excessive weight gain associated with pregnancy have not concurrently measured psychological, behavioral, and metabolic variables. Multidimensional assessment of many variables is needed to determine variables that may play a role in these excessive weight gains. For instance, psychological variables, such as increases in levels of depression or anxiety, could alter eating behavior. Alterations in eating patterns could lead to increased obesity during or after the pregnancy. Also, individual differences in energy utilization between women could lead to changes in specific taste preferences. Specific food preference changes could cause obesity in these women. Studies that examine and compare the relative importance of many different variables in the excess weight gains associated with pregnancy are not available in the literature. These variables need to be measured simultaneously to determine their relative contributions to the excessive body weight gain associated with pregnancy.

The present research was designed to determine the relative importance of several variables that may contribute to maternal weight

gains during and after pregnancy. The proposed work certainly does not exhaust the potential variables and interactions that may be involved. Instead, specific variables that may be important were examined in human and animal studies. These two particular study designs were chosen to address the same question with complementary information. Using animals in a laboratory setting enables longitudinal information about daily behaviors to be collected. A prospective design, with random assignment into groups and controlled environment and availability of food during the study, was also possible with the animal study. Invasive terminal measures could be taken with rats during and after pregnancy. Research with humans carried the question into a more naturalistic setting to collect information regarding the interaction of psychological and behavioral variables. The animal study contained the experimental control and prospective daily measurements, while the human study yielded more face-valid data about the actual population of interest. The human laboratory study measured psychological variables (i.e., emotional changes, social support, restraint, and stressful events) and behavioral variables (i.e., general and specific food consumption changes). Information about specific and general food consumption changes and how they relate to psychological variables in a normal pregnancy could lead to possible explanations for excess gains. The animal study measured behavioral variables (i.e., changes in specific food consumption) and biological variables (i.e., adipose tissue cellularity, size of various fat depots). Manipulating variables (i.e., availability of sweet tasting food when pregnant) that may play a role in excess weight gains during and after pregnancy will determine the

importance of sweet taste in any excessive gains. Taken together, these studies may lend insight into possible reasons for any pregnancy-associated excessive weight gains experienced by some women.

Hypotheses

The major hypotheses tested in the human study were as follows:

1. Time since last menstrual period will be positively related to weight gain for pregnant women.

Rationale: Weight gain during pregnancy is a sign of health. Because only healthy women were selected for this study, all women should gain weight with increasing time in pregnancy.

2. Total amount consumed in the laboratory session will be positively related to weight gain during pregnancy.

Rationale: Pregnant women require more available calories, especially at times when the fetus is growing rapidly in size. If women require more calories, then they will eat more to meet this requirement. The laboratory consumption will reflect this increase in consumption.

3. Sweet food consumption will show the strongest relationship to normal weight gains during pregnancy as compared with either salty or bland food consumption.

Rationale: Organisms in a state of caloric need prefer sweet food more than when they are satiated. If pregnant women need more calories, then they should show an increase in taste preference at times when they are eating the most and gaining the most weight.

4. Those women who are gaining excess weight will consume more sweet food in the laboratory than will women who are gaining normal amounts of weight.

Rationale: Since sweet food is usually high in calories (either fat or carbohydrate) excess consumption of this food will lead to excess weight gain.

5. Assuming that pregnancy is not stressful, prepregnancy levels of restrained eating will be negatively related to any excess weight gains: with increasing levels of restraint before pregnancy less weight will be gained.

Rationale: Women who are not very restrained and self-conscious about their eating and weight gains will eat freely during pregnancy and so will gain more weight. Women who are more restrained will hold back from eating what they want, and so will control weight gains. If pregnant women are stressed, the opposite prediction would be made: ongoing stress will disinhibit previously restrained eaters and will cause increased consumption and increased weight gains.

6. Previous weight history (weight fluctuation, maximum percent deviation from ideal weight) will be positively related to any excess weight gain during and after pregnancy.

Rationale: Previous weight fluctuation could predispose an individual to gaining excess weight later in life. If women have a history of fluctuating weight, then they should gain more weight during pregnancy than women for whom weight has always been at a steady level.

7. Depression and anxiety levels during pregnancy will be related to any excess weight differences during pregnancy.

Rationale: Changes in emotion can lead to changes in eating behavior and in body weight. To the extent that women are experiencing differences in affect during or after pregnancy, they should gain different

amounts of weight than should women whose affect levels are low or remain steady.

8. General stress (obstetrical problems, financial difficulties, etc.) will be positively related to affective differences (depression, anxiety) both during and after pregnancy.

Rationale: Over many situations increases in stress lead to changes in affect levels, including both anxiety and depression. In the current study general and specific stressors will be related to affect.

9. Social support will be negatively related to affective differences (depression, anxiety) both during and after pregnancy.

Rationale: Social support can buffer, or ameliorate, stress in many situations. A common result of the stress process is a change in affect.

The major hypotheses tested in the animal study were as follows:

1. Rats will gain weight throughout their pregnancies.

Rationale: Because of both the growing fetus and the necessary fetal support, rats will gain body weight throughout their pregnancies.

Because only healthy rats were used in the present study, all will gain weight.

2. Pregnant rats will consume more glucose solutions than will nonpregnant rats.

Rationale: The nutritional needs of pregnancy will result in a state of increased caloric need for the mother. Because organisms prefer sweet food during times of caloric need, pregnant rats provided with a sweet food will show an increased preference for that food and will consume more of it than nonpregnant rats.

3. Rats receiving glucose solutions and standard chow will gain more weight, store more adipose tissue, and develop larger adipocytes than rats receiving standard chow.

Rationale: Consumption of glucose solution without a concurrent decrease in consumption of bland chow is an increase in caloric consumption.

This increase in consumption will result in weight gain. Because the calories are not needed for nutrition, the increase in weight will be in adipose tissue. Adipose tissue stores increase via either increases in cell size or cell number. Because in adulthood it is difficult to produce increases in cell number, the increase in consumption will result in increases in cell size.

4. Pregnant rats will gain more weight, store more adipose tissue, and develop larger adipocytes than nonpregnant rats.

Rationale: Pregnancy causes an increase in body weight and an increase in adipose tissue. This adipose tissue increase will be expressed as an increase in cell size.

5. Pregnant rats receiving glucose solutions and standard chow will gain more weight, store more adipose tissue, and develop more and larger adipocytes than any other group of rats.

Rationale: Because of the increased consumption of sweet food and because of the weight gain during pregnancy, pregnant animals will show significantly more weight gain and adipose tissue growth than will any other group of rats. This large increase in adipose tissue will necessitate an increase in both cell size and number.

6. The uterine, subscapular, and parametrial fat pads will show the most weight increase during pregnancy, especially when rats are

provided with sweet food. Other pads (abdominal subcutaneous, subscapular) will increase only when rats are provided with two foods and when pregnant.

Rationale: The sizes of uterine, subscapular, and parametrial fat pads are modified by levels of circulating gonadal steroids. Since these steroids are increased during pregnancy, these pads should show the most weight gains during pregnancy, especially when more calories are consumed in the form of sweet food. Other fat pads will not be responsive to changes in steroid levels.

Human Study

Overview

This study was designed to examine psychological and behavioral variables that might suggest explanations for the excessive weight gains associated with pregnancy. Women in the first, second, or third trimester, or a postpartum period were asked to participate in a study of sensory perception changes during and after pregnancy. Subjects were asked to taste nine different foods and to rate each of them on a series of basic taste dimensions. After tasting the foods subjects were instructed to eat as much as they wanted of each of the foods. In reality the foods were weighed before and after the taste testing session to obtain measures of general and specific food consumption in the laboratory. The laboratory consumption session also provided inferential information about taste preferences during and after pregnancy. This deceptive manipulation was necessary to prevent self-consciousness about eating freely and to obtain an accurate measure of laboratory food consumption. After a twenty-minute tasting session subjects also filled out several questionnaires (e.g., measures of affect, stressful events). (Copies of these and all other questionnaires, including the script, are available in the Appendix.) These questionnaires gave a measure of general psychological functioning, as well as more standard measures of restrained eating and affect levels for each subject. Physical measures (e.g., height, weight, skinfold thicknesses) were taken. From these values two indices of obesity--the body mass index and percent body fat--were calculated. After the study subjects were paid and debriefed.

Subjects

Subjects for this study were 50 married women; 11, 15, and 12 from each of the three trimesters of pregnancy, respectively, and 12 postpartum subjects (average number of weeks postpartum = 6.5; range = 4-9). Women were equally distributed within each trimester period, except that no subjects were used in weeks 1-7. Subjects were recruited through a newspaper ad asking for women interested in sensory sensitivity changes during and after pregnancy. They ranged in age from 19-34 years and were healthy and free from obstetrical complications at the time of the study. These women were generally financially stable (mean family income = \$43,000, s.d. = 12,500) and relatively well-educated (40 of 50 had received a college diploma and the remaining had finished high school). Of the 50 subjects, 46 were currently employed or had been employed outside the home before leaving for their pregnancies. Demographics for subjects in each trimester period are presented in Table 1. There were no significant differences for any demographic variable over the study periods when analyzed with either analyses of variance or chi squares, where appropriate.

Measurements

Food consumption. Each subject was asked to taste nine different foods. These foods were weighed before and after the taste test to determine consumption of each food. Three sweet (e.g., coffee cake), three salty (e.g., salted peanuts), and three bland (e.g., cheese) foods, representing both meal and snack choices, were chosen for the study. (A list of specific foods is presented in the Appendix.) All foods were presented in bite-size portions in beige bowls. The order of foods was counterbalanced for food taste class. These foods were chosen

on the basis of taste class only, and were not balanced for nutritional content. Cold water was also available. The taste test was conducted in a 5' x 9' room with a table and chair for the subject and a chair for the experimenter to use while explaining the taste test. The results from this part of the study provided information about both general food consumption and specific taste preferences.

Physical measures. Height and weight were measured at the end of the laboratory session. A body mass index ($\text{weight}/\text{height}^2$) was calculated for each woman. The body mass index has a high correlation with obesity as measured with more accurate but involved methods (Bray, 1980). In addition, body mass indices were computed for each woman using a weight taken at her first obstetrical visit. Triceps and subcapsular skinfold thickness measurements also were taken with Lange Skinfold Calipers to determine percent body fat of each woman. This method has been shown to be 90 percent accurate in determining body fat in women (Sloane, Burt, & Blyth, 1962), as compared with other, more sophisticated methods such as underwater weighing.

Self-report Questionnaires

Affect. Subjects were given two questionnaires to assess affect: the Multiple Affect Adjective Checklist (MAACL) and the Beck Depression Inventory (BDI). The MAACL is a well-validated state assessment device with three subscales: depression, hostility, and anxiety (Zuckerman, 1960). Subjects were asked to check adjectives from the list that most closely corresponded to the way they have felt in the last two weeks. The BDI, a standard measure of major depression, also was given to each subject. The BDI asks subjects to choose one of four

statements that they agree with most from a list of 21 groups of statements (Beck, 1967). These two affect scales were used to assess both normal mood changes (using the MAACL) and depression (using the BDI).

Restraint. Two questionnaires are available to assess dietary restraint. One, developed by Herman & Polivy (1980), is a 10-item scale designed to measure behavioral restraint of eating. The other restraint scale is longer and contains three subscales, including conscious restraint in eating, behavioral and weight liability, and susceptibility to hunger (Stunkard & Messick, 1985). Both scales were used in the present study. Although both scales are used in eating and obesity research, the relationship between these two scales is not well-characterized in the literature and not at all in a pregnant population. The relationship between these two scales regarding changes in eating and weight associated with pregnancy was investigated by giving subjects both scales.

Social Support. The Interpersonal Support Evaluation List (ISEL) was used to determine the types and amounts of social support available for each subject (Cohen, Mermelstein, Kamarck, & Hoberman, 1985). The ISEL is a 40-item scale with 4 subscales: tangible support (material aid), appraisal support (perceived availability of having someone to talk to about oneself), self-esteem support (perceived potential of a positive comparison of oneself with others), and belonging support (perceived availability of having people around with whom to do things). Social support has been found to be important in determining mental health (Cohen, et al., 1985) as well as physical health (Wallston,

Alagna, DeVellis, & DeVellis, 1983; Singer & Lord, 1984).

Taste judgments. For each food that the subject tasted, she was asked to complete one taste judgment sheet. On each sheet was a list of taste dimensions. The subject was asked to circle a number between 1 (not at all) and 7 (extremely) for each of the following taste dimensions: sweet, sour, salty, bitter, spicy, flavorful/bland, smooth/-grainy, light/heavy, strong/mild, and fresh/stale. The judgments for each type of food were used as manipulation checks (i.e., did the "sweet" foods really taste sweet?) and as a method to evaluate taste perception in different subjects.

General questionnaire. Subjects were given a general questionnaire assessing many variables that could affect psychological well-being, including living situation, feelings about the present pregnancy, and financial status. Weight and obstetric histories were included in this questionnaire.

Procedure

Recruiting subjects. Possible subjects were telephoned and were asked to participate in a study of sensation and perception during the course of pregnancy. If they agreed they underwent a short initial telephone screening to insure freedom from obstetrical and health problems and absence of food allergies and dietary restrictions. The experimenter asked each potential subject questions about the present pregnancy and her general health. Subjects must not have smoked regularly in the past two years, to control for smoking and smoking cessation as variables that could influence both eating and body weight. Only married subjects were included to insure a baseline level of social

support for all participants. If the subject met all requirements, an appointment was scheduled for the laboratory session. Possible appointment times included from 3 pm to 8 pm on any day except Tuesday or Thursday. The night before the scheduled appointment all subjects received a telephone call reminding them of the appointment time and place. The experimenter asked them to eat their regular lunch, and to refrain from eating for 3 hours before their appointment.

Laboratory session. The experimenter greeted the subject and escorted her to the experimental suite where several rooms were set up with equipment to test for perception of different stimuli. Subjects were told that the study involved tests of sensation and perception, including sight, sound, and taste. The experimenter consulted a chart on her clipboard and informed every subject that "We don't have time in one experimental session to test everyone on all of their senses. You are in the taste condition. I'd like you to taste some everyday foods and to fill out some taste judgment questionnaires." This procedure was designed to avoid self-consciousness or suspicion about eating in relation to body weight.

The experimenter then escorted the subject into the taste room and explained to her the procedure for testing the foods and filling out the taste judgment forms. After the explanations, the experimenter said "It's important that your ratings are as accurate as possible, so eat as much of each food as you need in making your judgments. After you leave, I'm going to throw the foods out anyway, so you might as well eat what you want." The experimenter left the subject in the room for 20 minutes to taste the foods. Previous research (Grunberg, 1982) and

pretests have found that this amount of time is ample for the subjects to taste all the foods and then to nibble.¹

The experimenter returned to the room after the 20 minute period and said, "We're done with the taste testing part of the study now. One more thing before you go--of the nine foods that you tasted today, which were your three favorite in order?" The answer to this question provided more data on the taste preferences of the subject. After recording the subject's responses, the experimenter took the subject to a nearby room in the suite and gave her a packet of questionnaires to complete. After she was finished, the physical measures were taken and the subject was paid \$20 and debriefed. This procedure was based on previous research on taste preferences and food (Grunberg, 1982). Pilot subjects were run to refine techniques and to develop the exact procedures for this study.¹ A copy of the entire script, including the initial screening interview, is provided in the Appendix.

Data Analyses

The first section of the data analyses involved simple bivariate comparisons for each of the major hypotheses. For example, a one-way analysis of variance was performed with trimester of pregnancy as the dependent variable and sweet food consumption as the independent variable.

The second section of analyses was an attempt to determine complex relationships between classes of variables in the present study. Multiple regression/correlation analyses were used to determine the relative contribution of several variables to any body fat gains associated with pregnancy. The body mass index, weight gain divided by week of pregnancy, and percent body fat of each woman were separately

regressed on psychological and behavioral variables using hierarchical multiple regressions. Body mass index calculated using each subject's weight from her first obstetrical visit was entered first in these analyses to control for prepregnancy weight. Variables were entered in an a priori hypothetical order of importance, e.g., first psychological variables and then behavioral variables, to determine the causes of the weight differences associated with pregnancy in the present study. These analyses were based on those developed by Cohen and Cohen (1983). Using hierarchical multiple regression techniques with several hypotheses about the data, it is possible to determine the importance of several types of independent variables in relation to the dependent variable, and to determine the likely causes of the excessive weight gains associated with pregnancy in the present study.

A third type of analysis compared each woman's actual weight at time of study with her weight predicted from a regression using demographics as independent variables. These demographics included week of pregnancy, parity, age, first obstetrical weight, and body mass index at time of first obstetrical visit. This analysis attempted to determine which women in the present study, if any, were gaining differential amounts of weight for their particular time in pregnancy.

Results

Behavioral Data. Figures 1 through 6 present the results of the laboratory food consumption measurements combined into four pregnancy study periods: first trimester (weeks 1-15), second trimester (weeks 16-27), third trimester (weeks 28-birth), and postpartum (all postpartum

weeks). Total consumption of all foods in each food class (sweet, salty, and bland) is presented separately, and then summed up for a total food consumption analysis in both grams and calories.²

The results of the sweet food consumption are presented in Figure 1. Subjects in the second trimester consumed more sweet food than did the subjects in any other period. A one-way analysis of variance statistically confirmed this observation ($F = 9.72$, $df = 3,42$; $p = 0.0001$). Using a Newman-Keuls range test to compare individual groups, women in the second trimester consumed significantly more sweet food than did women from any other group. No other individual group comparisons were significantly different. When each consumption of food was analyzed separately, results were similar to results for all sweet foods.

Figure 2 represents the salty food consumption values over the four pregnancy periods. Women in their third trimester of pregnancy consumed more salty food than did subjects in either of the other trimesters or during the postpartum period. A one-way analysis of variance indicated that this difference was marginally significant ($F = 2.2371$, $df = 3,42$; $p < 0.098$).

The bland food consumption values are presented in Figure 3. A one-way analysis of variance revealed no significant differences in bland food consumption ($F = 1.14$, $df = 3,43$; ns). Note that the absolute differences between pregnancy periods, although consistent, were small.

Consumptions in all three separate food classes are presented together in Figure 4. During the second trimester, sweet food consumption was substantially greater than consumption of the other two classes.

This difference was not evident during the other experimental periods. Consumption of salty food increased almost to the level of sweet food during the third trimester, but not during either of the other trimesters or during the postpartum period. In fact, consumption patterns during the first trimester look remarkably similar to those during the postpartum period in the present study.

Figure 5 presents the total food consumption as a sum of sweet, salty, and bland food consumption. Over the four periods laboratory food consumption computed in grams of food was relatively similar. These slight differences in total grams consumed were not statistically significant ($F = 2.02$, $df = 3,42$; ns).

Total laboratory consumption shown as kilocalories consumed is presented in Figure 6. Subjects in the second trimester consumed more calories in the laboratory than did subjects in any other period. The group differences were statistically significant using an analysis of variance ($F = 2.81$; $df = 3,42$; $p < 0.05$). A Newman-Keuls range test confirmed that women in period 2 consumed significantly more as compared with any other group. No other group differed significantly. This difference in caloric consumption differed from the similarity of consumption values when expressed as grams of food consumed.

Figure 7 presents the mean sweetness ratings (scale range is 1-7 where 1 = extremely sweet) of the three sweet foods for subjects in each of the pregnancy periods. A one-way analysis of variance revealed no significant difference in the subjects' ratings ($F = 1.27$; $df = 3,40$; ns). Mean saltiness ratings (scale range is 1-7 where 1 = extremely salty) for foods in the salty class across each of the pregnancy periods are shown in Figure 8. Subjects tested in the third trimester and

during the postpartum period rated their salty foods as less salty than did subjects in either of the two other periods. The overall differences in saltiness ratings were statistically significant using a one-way analysis of variance ($F = 4.80$; $df = 3,40$; $p < 0.01$). None of the other ratings for any taste class were statistically different over the study periods using similar statistical methods. Using a Newman-Keuls range test to compare individual groups, saltiness ratings of women in Periods 3 and 4 were different from ratings in Periods 1 and 2. No other comparisons were significantly different.

In sum, women in the second trimester of pregnancy consumed significantly more sweet food than did women in any other pregnancy study period. Third trimester women consumed slightly more salty food than did women in other pregnancy study periods. There were no differences in consumption of bland food or total food for any study period when consumption was expressed in grams. However, it is important to note that women in the second trimester consumed more calories in the laboratory than did women in any other trimester. Taste perception ratings for sweetness did not differ for subjects in any of the pregnancy periods, but women in the third trimester rated their salty foods as being less salty than did women in the other pregnancy periods. This rating change corresponded with the higher level of salty food consumption during the third trimester.

Physical Data. Figure 9 presents the weight gained by each of the subjects from the first obstetrical weight to the time of the laboratory study. Weight gain increased from first to third trimester for subjects in the present study. The weight gains are approximately

equal to guidelines set by the American College of Obstetrics and Gynecology. Data for the postpartum subjects showed a slight weight gain (roughly 7 pounds) from prepregnancy levels that remained after the birth of the child. When analyzed using a one-way analysis of variance, weight gain values significantly differ for women in different pregnancy groups ($F = 12.74$; $df = 3,46$; $p < 0.001$). A Newman-Keuls range test for individual group differences reveals that gains in Period 4 differed from gains in Periods 2 and 3, and that Periods 1 and 2 gains differed from gains in Period 3. Other periods did not differ significantly.

The percent body fat values for women in the present study are graphed in Figure 10. Overall, the values are slightly higher than the average percent body fat of American women (average female per cent body fat for U.S. = 20-25 percent). Body fat was slightly higher for each successive trimester and then was slightly lower for women in the postpartum period. These data were significantly different across pregnancy groups using a one-way analysis of variance ($F = 2.99$; $df = 3,46$; $p < 0.05$). Percent body fat of women in the third trimester differed from all other groups using a Neuman-Keuls range test, with no other comparisons being significant.

Figure 11 displays the body mass index (weight/height squared, BMI) means computed from values taken at the time of study participation for all subjects. In Figure 11 the body mass index was higher for women in each successive trimester. Postpartum values were lower than those in the third trimester. A one-way analysis of variance revealed significant differences between BMI's for the pregnancy groups ($F = 2.933$; $df = 3,46$; $p < 0.05$). BMI's for women in the third trimester statistically differed from BMI's in all other trimesters using a Neuman-Keuls range

test. No other individual comparisons differed significantly. In contrast to BMI's at the time of the study, BMI's calculated using body weight from the first obstetrical visit were virtually identical for women in each of the study periods (see Table 1).

Figure 12 presents a frequency distribution of the difference between actual and predicted weight for each women. Each woman's predicted weight was calculated from the regression equation using demographic variables, such as week of pregnancy and first obstetrical weight. The variance in differential weight gain was small in the present sample, as shown by the relatively narrow range in the distribution in Figure 12. No women gained more than 15 pounds in excess of her weight predicted by the regression, or less than 15 pounds below her predicted weight. Generally, the particular sample in the present study was restricted to women who gained normal amounts of weight during pregnancy.

Psychological Data. Table 2 presents a correlation matrix for the psychological variables used in the present study. The social support total scale score (ISELT) correlated positively and significantly with each of its subscales (ISEL1, appraisal support; ISEL2, belonging support; ISEL3, tangible support; and ISEL4, self-esteem support). People high in one type of social support were likely to perceive themselves as high in other types. In general women in the present study reported that they had large amounts of support of all types (mean score for ISELT= 36.18; possible scale range = 0-40; standard norms not yet published). The Multiple Affect Adjective Check List subscales (MAACL1, anxiety; MAACL2, depression; and MAACL3, hostility) were also correlated significantly with the total scale score, MAACLT. Scores on

the MAACL were comparable to average unstressed scores of college students (mean for MAACLT = 22.1; possible scale range = 0-89; no normative data available for pregnancy). The Stunkard Restraint Scale total score (STUNKT) was correlated significantly with the subscale scores (STUNK1, cognitive restraint, STUNK2, hunger, STUNK3, weight lability). Scores on the Stunkard restraint scale were generally high for normal individuals (mean for STUNKT = 26.31, possible scale range = 0-51; no standard norms published but mean score in this range is high for normal population).

There were several patterns of correlation between psychological scales in the present study. The STUNKT was positively and significantly highly correlated with scores on the Herman and Polivy restraint scales (HP). This relationship was expected, because the Stunkard scale was developed, in part, using items from the HP. The Beck Depression scale was positively and significantly correlated with scores on the MAACL and negatively and significantly correlated with ISEL scores. In general subjects evidenced consistent patterns of low scores on the Beck and MAACL and relatively high scores on the ISEL. The stress index (TOTSTR; scale range 1-7, computed as the average to 8 questions from the General Questionnaire regarding general problems and hassles specific to pregnancy) did not correlate with indices of either affect (MAACLT) or social support (ISELT).

Table 3 includes a correlation matrix showing relationships between behavioral variables and the total scale scores for selected self-report variables. Several patterns of correlation emerged in this table. The three measures of obesity--the BMI1 (BMI at time of laboratory); BMI2 (BMI before pregnancy); and FAT (percent body fat at time of

study), were interrelated in the present study. The BMI's were very highly correlated with each other, and both were correlated significantly with FAT. Both the HP and the STUNKT were positively and significantly correlated with all three indices of obesity. This restraint-obesity relationship possibly means that level of restraint determined both the generally low prepregnancy obesity levels and the minimal excess weight gains of subjects in the present study. TOTSTR, the index of currently experienced stress for each subject, was significantly and positively correlated with amounts of sweet, bland, and total food consumed during the laboratory study (SWATE, BLATE, and TTATE). Food consumption in the laboratory was positively related to perceived stress during and after pregnancy.

Hierarchical multiple regression/correlation analyses were performed separately for three dependent variables: amount of weight gained at time of study, weight gained at time of study divided by week of pregnancy (rate of gain), and percent body fat at time of study. Entered first as a group into the regression equation were the psychological variables STUNKT, HP, MAACLT, ISELT, and TOTSTR. The second entry into the equation included the behavioral variables: SWATE, SAATE, and BLATE. Both regressions were calculated with and without values from subjects in the fourth study period (the postpartum group). Neither group of variables accounted for a significant amount of variance in any of the regression equations.

Discussion

The results of the present study suggested that over the course of pregnancy preferences for sweet foods changed. Women in the second trimester consumed more sweet-tasting food than did women in any other

pregnancy study period. This difference was not due to changes in the perception of sweet taste, for there were no significant differences in the sweetness ratings of the sweet foods for any group of subjects. Subjects in all study periods rated the sweet foods as tasting similarly sweet. This increase in consumption of sweet foods, if excessive, could lead to excess weight gains for women during pregnancy.

Consumption of salty foods also differed for women across pregnancy periods. Women in the third trimester consumed more salty foods than did any other group of women in the present study, a finding that approached significance. This behavioral change corresponded to a change in the taste perception of the salty foods for women in the third trimester, who rated those foods as not tasting as salty as did other women. This is an interesting point, because in the later trimesters of pregnancy women are vulnerable to eclampsia, or pregnancy-induced hypertension. Whether or not consumption of salty foods is involved in this serious problem is unclear from the present study. Women with eclampsia could experience a change in taste perception for salty foods, consume more of these foods, and so unknowingly assist in the development of this obstetrical problem.

When amount eaten was expressed as grams of food consumed, there were no differences in total food consumption in the present study. There were, however, significant differences in the number of calories consumed. The increase in caloric consumption in the second trimester resulted from the increase in consumption of sweet-tasting high caloric foods such as coffee cake and candy. This increased consumption of high caloric foods might contribute to excess weight gains if continued in more naturalistic daily food consumption.

In general women in the present study gained a normal amount of weight for their particular time in pregnancy. Because of this limited sample there was no way to compare women who were gaining excess weight with women who gained normal amounts of weight. Note that women in the postpartum period had not returned to their prepregnancy levels of weight by the time of the study (See Figures 9-11). With each pregnancy women gain extra weight that remains with them after delivery. This weight could predispose them for excess gains in subsequent pregnancies. In the present study numbers of primiparous and multiparous women did not differ across the four Study Periods when compared with a χ^2 (4 periods) by 2 (primi- versus multiparous) chi square analysis. Some of the cells, however, contained four and five women. This sample size was not large enough to compare women of differing parity across study periods using analyses of variance. This is important to further research, since possibly women of increasing parity gain more weight with each additional pregnancy.

The subjects in the present study were well-equipped with social support, as evidenced from their high ISEL scores. Their scores on the MAACL evidenced low emotional turmoil as well. No one was experiencing a major depressive episode, using the Beck score as a criterion of depression. They were restrained eaters, as shown from their scores on both the STUNK and on the HP restraint scales. In general the subjects in the present study were happy, reported low levels of stress and emotional upset, had enough money and medical care (all women were seeing either an obstetrician or a nurse-practitioner and were receiving adequate prenatal care according to American College of Obstetrics and

Gynecology standards) and were surrounded by support from friends and family.

Although women in the second trimester exhibited an increase in consumption of sweet foods in the present laboratory study (and by inference an increase in taste preference for those foods) they did not gain excessive weight during their pregnancies. The answer to this puzzle may lie in the relatively high levels of restraint reported by these women. Possibly, these women were so restrained that they would hold back from eating foods so that they would not consume increased amounts for fear of gaining weight. For other women who were not so restrained, an increase in preference might lead to an increase in daily consumption and so to increased weight. An attempt was made in the laboratory study to allow the women to feel as comfortable and relaxed as possible. They might have eaten more sweet foods in the present study because of a second-trimester preference change but would restrain themselves from eating extra amounts of food when in a more familiar environment. This possibility needs to be investigated both using naturalistic methods of actual daily food consumption collection and also in other populations that might not be as restrained as were women in the present study.

It may be relevant to note that the multiple regression/correlation analyses in the present study yielded no significant findings. The highest amounts of adipose tissue occurred for women in the third trimester, whereas the increase in sweet preference occurred during the second trimester. If excess weight gains had corresponded to weight gains in the second trimester, the multiple regression would have significantly predicted adipose tissue from amount of sweet food eaten

in the laboratory. This particular statistical analysis might be more useful in populations where sweet preferences are related to increases in daily food intake and where women are gaining excess weight. The difference between a given subject's predicted and actual weight would possibly have been useful as a dependent variable in a regression analysis if there had been a broader range of difference scores (i.e., if some women had gained excess amounts of weight). Psychological and behavioral variables in the present study might have been more useful as predictors of weight gain if that gain were excessive instead of normal.

Also, this change in food preference and consumption may have implications for proper nutritional intake during pregnancy. Women who are not educated as to proper prenatal nutrition may be allowing their preferences to guide their food choice during pregnancy. To the extent that they prefer sweet-tasting foods, these women may not be selecting their diets to consist mainly of nonsweet foods that are very nutritious. Low income and minority populations that might not have access to adequate prenatal or nutritional care are the same groups that gain the most excess pregnancy-associated weight. These populations also have the highest incidence of low-birthweight infants. The role of dietary intake, taste preference changes, and nutritional advice in the incidence of low-birthweight infants remains to be investigated.

Cigarette smoking is another variable that could modify excess weight gains associated with pregnancy. The women in the present study were all nonsmokers and so for them smoking and cessation of smoking could not influence their gains. Women are often advised by their physicians to quit smoking while pregnant to prevent possible infant

health problems. Because sweet food consumption often increases after cessation of smoking (Grunberg, 1982a), women who quit smoking may be at risk for excess weight gain as compared to nonsmoking pregnant women because of a large increase in preference for sweet-tasting food.

The present study was restricted to a short-term laboratory assessment of food intake measured cross-sectionally during and after pregnancy. To more carefully assess the relationship between eating and body weight changes, these variables need to be measured daily both during and after pregnancy. In addition, if subjects less influenced by psychological variables, like restraint, could be found and studied, then the relationship between taste preferences and daily food consumption could be investigated. Also useful would be a thorough assessment of body composition and adipose tissue characteristics simultaneously with the assessment of behavioral changes. To satisfy these demands, an animal study was designed to investigate pregnancy-associated weight gains.

Animal Study

Overview

This study was designed to examine the effects of taste preference, eating behavior, and biological factors on the body weight gains associated with pregnancy in rats. Subjects included rats that were impregnated during the study and rats that were not impregnated. Throughout the study half of each of these two groups were provided with bland laboratory chow and half were provided with the bland laboratory chow and a sweet-tasting food. This procedure was designed to determine the contribution of changes in specific food consumption to excess body weight gains during pregnancy. Body weight, consumption of both types of food, and water consumption were measured daily before, during, and after pregnancy. At the end of the gestation period half of the rats from each of the four groups (pregnant with two foods, pregnant with one food, nonpregnant with one food, and nonpregnant with two foods) were killed, and adipose tissue cellularity analyses were performed on each rat. After 20 daily postpartum measurements, the remaining rats were killed and adipose tissue analyses were performed.

Subjects and Housing

Rats were chosen as an appropriate animal model for human pregnancy and taste preference studies for several reasons. First, the physiological factors that maintain pregnancy are similar in rats and humans (Wade, 1979; Weisenbaum et al., 1979; Rands et al., 1982). Second, gonadal steroids and other hormones that affect body weight, adipose tissue deposits, and food consumption in humans appear to have similar effects in rats (Wade, 1976; Pliner & Fleming, 1983). Finally, rats and humans appear to have similar taste thresholds to a variety of

tastes (Richter & Campbell, 1939-40). One factor that may limit the use of rats as a model for human pregnancy and weight gain is the differing patterns of weight increase for rats and humans across the lifespan. Rats, unlike humans, continue to gain weight until their death, although the rate of gain slows with age. Careful comparisons of amounts and rates of gain between pregnant and nonpregnant rats is necessary to account for this normal longterm weight gain. Another limitation of the rat as a model of human pregnancy is the difference in average number of offspring per pregnancy: rats produce an average of 10-12 pups, while an average human pregnancy results in one offspring. Comparison of data concerning any effects on offspring must consider litter size if rats are used as a model of pregnancy and biological processes in humans.

At the beginning of the study, subjects were 48 120-day-old virgin female Sprague-Dawley rats. Upon arrival, the rats were individually housed in standard plastic shoebox cages with Pine-Dri wood shavings. The animal room was maintained on a 12-hour light/dark cycle at 22°C and 50 percent relative humidity. Before the study began, a standard rodent pellet diet and water were freely available to all animals.

During the study standard ground rodent meal was provided in round stainless steel cups fitted with lids and lid clips to prevent spillage. Tap water and glucose solutions (where appropriate) were provided in plastic bottles with rubber stoppers and stainless steel sipper tubes. Twenty-four 300g male Sprague-Dawley rats were used to impregnate half of the female rats.

Methods

Daily measurements. Body weight, food consumption, and water consumption were measured daily throughout the study except when two rats were housed in the same cage (i.e., during conception). Rats were weighed using a Sartorius programmable electronic balance equipped with a Sartorius printer/programmer. The balance was programmed to calculate body weight as a mean of 10 consecutive weighings taken at 1-second intervals to compensate for animal movement. Food and water were weighed daily, refilled if necessary, and reweighed before being returned to the animals' cages. The previous day's food or water weight was subtracted to provide that day's consumption value.

Glucose solutions. Glucose solutions were 30 percent weight/volume d-glucose (e.g., 30g d-glucose per 100ml of solution). The solutions were allowed to stand for 12 hours before using to allow for stabilization of mutarotation. This concentration was based on the work of Grunberg (1982) and Jacobs (1958), who found these solutions to be easily discriminated and preferred by rats. The extra solution was refrigerated, and new stock was prepared weekly.

Adipose tissue analyses. At the time of euthanasia (i.p. injection of an overdose of pentobarbital), adipose tissue pads were removed from each animal and weighed to estimate the amount of fat in each animal. A number of sites were used. The parametrial and subscapular deposits (taken unilaterally), were used because they appear to be particularly sensitive to energy needs in female rats (Steingrimsdottir, Brasel & Greenwood, 1982; Lemonnier, 1972). In addition, the abdominal subcutaneous deposit (taken unilaterally) gives similar results for both sexes. All three pads were removed and weighed.

Adipose cell size and number were determined by the method of Hirsch & Gallian (1968).³ Basically, adipose tissue was removed from a particular fat depot, weighed, and fixed in osmium tetroxide. Each osmium/tissue mixture was washed with saline through a series of filters with differing pore sizes. The first filter allowed fixed cells to pass through, but trapped connective tissue and other debris. The second filter caught adipose cells for a final wash. The cells were counted automatically as they passed through the small aperture of a Coulter counter and Coulter automatic particle size distribution analyzer. The passage of the cells of the adipose tissue interferes with the electrical conductivity in the aperture, providing both cell number and a frequency distribution of the cell size. The adipocyte-number hypothesis (Roche, 1981) and the set-point theory (Nisbett, 1974) state that adipocyte number is fixed early in life and that during adulthood increases in obesity are associated with increases in fat cell size, but not number. Although for most conditions this theory is true, evidence suggests that under some circumstances adipose cell number can be increased in adult life (Faust, Johnson, Stern, & Hirsch, 1978). Information about adipose tissue cellularity may provide insight into the mechanisms of obesity that could occur during pregnancy when rats are provided with different diets.

Estrus Cycles. Throughout the study the estrus cycles of the female rats were monitored when the rats were not pregnant. Estrus cycle staging is necessary because body weight, food consumption, and metabolism vary over the estrus cycle (Wade, 1979). Daily vaginal lavages of the rats were taken and changes noted in vaginal cytology to determine which of the stages of the estrus cycle the rat was in:

estrus, metestrus, diestrus, or proestrus. A 1 ml syringe was filled with 0.1 ml of physiological saline, and the tip was carefully inserted into the rat's vagina. The saline was pushed into the vagina and gently withdrawn with the syringe. The collected fluid was placed on one end of a microscope slide and smeared with a second slide. The smear was placed under a light microscope at 40x magnification. The following criteria was used in deciding which stage of the estrus cycle each rat was in: estrus, presence of cornified epithelial cells only; metestrus, presence of 50 percent cornified cells and 50 percent leukocytes; diestrus, presence of leukocytes only; and proestrus, presence of round epithelial cells only (Hafez, 1970).

Conception. At the appropriate time in the study, 24 of the females were mated. On the day of estrus, a male rat was placed in the female's cage. Vaginal smears were obtained daily from the female to detect the presence of sperm in the vaginal fluid. The first day that sperm was microscopically detected was counted as Day 1 of pregnancy and the male was removed from the cage. Previous research has shown this method of impregnating rats to be effective in 9/10 rats (Baker, Lindsey, & Weisbroth, 1979). This method of impregnating rats was piloted in this laboratory using 120-day old virgin females of the same strain as was used in this study. This method was successful in 9/10 subjects.

Procedure

All rats were gentled daily for a week before the study. At the start of the study, all female rats were provided with one of two diets. All females received bland meal. In addition, half of the pregnancy and half of the nonpregnancy group were provided with a bottle filled with

the glucose solution. Therefore, half of the females had access to only bland food and half had access to both a bland food and a sweet-tasting food. Rats were assigned to these and all groups so that each food group or pregnancy group had the same initial mean body weight. Body weight, consumption of both foods, and water consumption were measured daily. After 10 days of pre-pregnancy measurements, matings were attempted on the next day of estrus for half of the rats. Glucose solutions were removed from the females' cages during the time that the male was present. At this time each female in the pregnancy glucose solution group was matched with a female in the nonpregnancy glucose solution group to control for amount of exposure to the glucose solution. When sperm were found in the vaginal smear, the male was removed from the female's cage and daily body weight, food consumption, and water consumption measurements resumed. On Day 20 of pregnancy half of the animals from each group (pregnant with bland only or bland plus glucose solution and nonpregnant with bland only or bland plus glucose solution) were killed, adipose tissue pads were weighed, and 2 pads were fixed for later analyses. The fetoplacental unit was separated from the mother's body and weighed. Number and weight of fetuses also were recorded. Body weight, food consumption, and water consumption were measured daily for 20 days after delivery for all postpartum animals. On the twentieth day after delivery, the remaining females were killed and adipose tissue analyses were performed.

Data Analyses

Data collected daily--e.g., body weight, food consumption, and water consumption--were expressed as daily means for each of the food-by-pregnancy groups. These data were used to describe the time course

of weight and consumption changes over the course of pregnancy. For purposes of statistical analysis, body weight, consumption of each food, and water consumption were expressed as five six-day means, one before the pregnancy period, two during the pregnancy period, and two after the pregnancy period for each rat. Six day means were chosen to provide stability in the mean values and still incorporate as much of each period into the analyses as possible. Three of these values (one from each of the pregnancy periods) were used in analyses of variance with two independent variables: (1) pregnancy (pregnant or nonpregnant rats); and (2) food type (rats supplied with bland food only or bland and sweet-tasting, high caloric foods). An analysis of variance was used to test differences in adipose tissue cellularity between the four groups (pregnancy by food type). A separate statistical analysis of variance was performed for each tissue measurement point, one during the pregnancy period and one after the pregnancy period.

Results

Body Weight and Behavioral Data. Figures 13-16 present results of the behavioral variables measured daily before, during, and after pregnancy. For graphical presentation to represent change across the entire study, the data are grouped into five 6-day means evenly spaced throughout the study. On each graph Period 1 represents the mean for the 6 days before impregnation, or days 3-8 during the baseline measurements. Periods 2 and 3 were chosen as two 6-day means: the first beginning two days after impregnation (Days 13-18) and the second beginning 9 days before the first kill (Days 23-28). Periods 4 and 5 were selected from the postpartum period. Period 4 consists of the mean from Days 33-38 and Period 5 represents the mean from values for Days

43-48. These means were chosen for two reasons: 1) stability of mean value was necessary to insure that means were not dramatically influenced by outliers, and 2) these means accurately represented the patterns of change across the study for all variables. Analyses of variance were computed for Periods 1, 3, and 4, as representing each of the periods. These three particular periods were chosen for statistical analysis because they were the periods of most rapid change in eating behavior and because they gave the clearest picture of the overall period values. These analyses were computed using two independent variables: food condition (animals provided with either bland food or bland food plus glucose solution) and pregnancy condition (animals either pregnant or not pregnant).

Figure 13 presents the results of body weight measured before, during, and after pregnancy for each of the four conditions. Before pregnancy the body weights for each of the four conditions were similar and did not statistically differ ($F = 1.786$; $df = 1,44$, ns). At Period 3 pregnant rats weighed more than did their nonpregnant counterparts. This finding was statically significant ($F = 5.547$; $df = 1,44$, $p < 0.05$). Pregnant rats provided with two foods (bland plus glucose) weighed more than did any other group of rats, but this interaction was not significant. After delivery at Period 4 the body weights of previously pregnant rats were again similar to those of nonpregnant rats across both food conditions. Previously pregnant rats receiving two foods weighed more than did any other group of rats at this time point, but again this difference was not statistically significant.

The bland food consumption values for subjects across the entire study are presented in Figure 14. Rats receiving two foods ate significantly less bland food than did rats receiving only bland food ($F = 23.831$, $df = 1,44$; $p < 0.001$). Rats in the two pregnancy groups did not differ in their bland food consumption before pregnancy ($F = 0.053$; $df = 1,44$; ns). At Period 3 pregnant rats were consuming more bland food than were nonpregnant rats ($F = 37.86$; $df = 1,44$; $p < 0.001$), and rats receiving only one food were consuming more bland food than rats receiving two foods ($F = 25.93$; $df = 1,44$; $p < 0.001$). Pregnant rats receiving only one food consumed the most of all four groups during the pregnancy period; this interaction was not significant. At Period 4 previously pregnant rats were consuming significantly more than their nonpregnant controls ($F = 48.54$; $df = 1,21$; $p < 0.001$). Rats having access to one food consumed more bland food than did those that had access to both foods ($F = 54.38$; $df = 1,21$; $p < 0.001$). Previously pregnant rats with access to only bland chow consumed much more than did any other group of rats. This interaction was significant ($F = 29.18$; $df = 1,21$; $p < 0.001$). Rats consumed more bland food during pregnancy and when no other food, such as a glucose solution, was available.

The mean values for glucose solution consumption are presented in Figure 15. Before pregnancy both groups of rats consumed similar amounts ($F = 0.982$; $df = 1,21$; ns). During Period 3 pregnant rats consumed more glucose solution than did their nonpregnant controls. This difference was statistically significant using a one-way analysis of variance ($F = 9.736$; $df = 1,21$; $p < 0.01$). In the postpartum period (Periods 4 and 5) previously pregnant rats consumed more glucose solution than did nonpregnant rats. This difference was statistically

significant at Period 4 ($F = 12.749$; $df = 1,21$; $p < 0.001$). When pregnant and postpartum rats were provided with sweet-tasting high caloric food, they consumed more than did control animals.

Figure 16 presents the water consumption values for the entire study. During the prepregnancy period (Period 1) rats receiving two foods drank significantly less water than did rats receiving only one food ($F = 23.09$; $df = 1,44$; $p < 0.001$). This same pattern was repeated for Period 3 ($F = 17.26$; $df = 1,44$; $p < 0.001$). Both pregnant and nonpregnant rats drank more water if they were given access to only one food than if they were given access to bland food plus a glucose solution. During the postpartum Period 4, previously pregnant rats given access to two foods decreased their water intake relative to the other groups; this interaction was marginally significant ($F = 3.43$; $df = 1,21$, $p < 0.07$).

In sum, pregnant rats ate more bland food as compared with their nonpregnant counterparts. Similarly, pregnant rats consumed more glucose solution than did control subjects. After delivery previously pregnant rats receiving only bland food maintained their high consumption of this food. In contrast, postpartum rats provided with two foods decreased their consumption of the bland food but continued more glucose solution than did controls. Rats receiving two foods generally drank less water than did those receiving only bland food. This decreased in water consumption presumably occurred because rats provided with two foods were obtaining the liquid food and so needed less plain water.

Biological data. Figures 17-24 represent values for biological variables measured at the time the rats were killed. For each graph the first group of values--during pregnancy--were collected at Day 21 of

pregnancy for half of the rats in each pregnancy/food condition. The second group of values--after pregnancy--represent data collection at 18 days postpartum. All previously pregnant rats represented in these groups were lactating at the time of their death. Data were analyzed for each dependent variable using an analysis of variance with two independent variables; 1) food condition--only bland food or bland food plus glucose solution; and 2) pregnancy condition--pregnant or nonpregnant. These analyses were performed separately for each time point.⁴

Figure 17 presents the means for sums of all adipose tissue pads removed from animals in each of the pregnancy/food groups. During pregnancy pregnant animals contained significantly more adipose tissue than did their nonpregnant counterparts ($F = 4.978$; $df = 1,21$; $p < 0.01$). Pregnant animals provided with bland food plus a glucose solution contained more fat than did any other group of animals. After pregnancy a similar pattern appeared in the data. Pregnant animals and animals with two foods were fatter than their controls ($F = 6.213$; $df = 1,21$; $p < 0.06$; $F = 5.672$; $df = 1,21$; $p < 0.05$; respectively). Again, animals in the pregnant/two-foods condition contained the most fat of any other group.

Figure 18 shows the mean values for parametrial fat pad weight for each group during and after pregnancy. During pregnancy the parametrial fat pads of pregnant animals and animals with two foods were significantly heavier than those of controls ($F = 5.524$; $df = 1,21$; $F = 14.118$; $df = 1,21$; $p < 0.01$). After pregnancy animals provided with two foods had heavier pads than did control ($F = 5.214$; $df = 1,21$; $p < 0.05$). In addition, the pregnant/two-foods group had the heaviest pads of any

other group. This interaction was significant ($F = 4.770$; $df = 1,21$; $p < 0.05$).

Mean values for uterine fat pad weight are presented in Figure 19. The main effects of both food and pregnancy conditions were significant ($F = 16.116$; $df = 1,21$; $p < 0.01$ and $F = 19.43$; $df = 1,21$; $p < 0.05$). As the graph illustrates, the interaction between food and pregnancy was also significant ($F = 7.646$; $df = 1,21$; $p < 0.05$). Pregnant animals with two foods had by far the heaviest uterine fat pads of any of the groups. After pregnancy there were no significant differences in uterine pad weight between any of the groups.

Figure 20 presents means for abdominal subcutaneous fat pad weight for all groups during and after pregnancy. Pad weight of pregnant animals were significantly different from those of nonpregnant animals during pregnancy ($F = 8.786$; $df = 1,21$; $p < 0.001$). After pregnancy animals provided with two foods had significantly heavier pads than those provided with only one food ($F = 5.247$; $df = 1,21$; $p < 0.05$). No other differences in fat pad weight were significant.

Figure 21 presents the mean weight for the subscapular fat pad for all groups during and after pregnancy. During and after pregnancy the only significant findings were those of the interactions between food and pregnancy condition ($F = 5.299$; $df = 1,21$; $p < 0.05$ and $F = 6.983$; $df = 1,21$; $p < 0.01$ for during and after pregnancy). In both cases animals in the pregnant/two-foods group had the highest fat pad weight of any other group.

Adipose cell size data for the parametrial and subscapular fat pad are shown in Figures 22 and 23. Figure 22 presents data for the

parametrial fat pad during and after pregnancy. During the pregnancy period pregnant rats and rats provided with two foods had larger adipose cells in their parametrial fat pads than did appropriate controls ($F = 4.938$; $df = 1,21$; $p < 0.05$ and $F = 5.377$; $df = 1,21$; $p < 0.05$ for food and pregnancy conditions, respectively). After pregnancy animals with two foods had larger cells in the parametrial fat pads than did animals with one food ($F = 4.621$; $df = 1,21$; $p < 0.05$). Previously pregnant animals with two foods had the largest parametrial cells of any group; this interaction was statistically significant ($F = 6.103$; $df = 1,21$; $p < 0.05$). The adipose cell size data for the subscapular fat pad is shown in Figure 23. At both time periods the largest cells were found in the pregnant/two-foods group. For both periods the interaction was significant ($F = 7.302$; $df = 1,21$; $p < 0.01$ and $F = 5.398$; $df = 1,21$; $p < 0.05$ for during and after pregnancy, respectively). Provisions of sweet-tasting high caloric food during pregnancy or during lactation is associated with larger adipose cells. There were no differences in adipose cell number for either fat pad at any time period in the present study.

Figure 24 depicts the reproductive organ weight of all groups during and after pregnancy. As expected, pregnant animals had higher organ weights than did nonpregnant animals ($F = 46.891$; $df = 1,21$; $p < 0.001$). After pregnancy there were no significant differences among any of the groups.

Discussion

The data from the present study suggest that sweet food consumption can be involved in excess body fat gains that accompany pregnancy.

Animals provided with sweet food during pregnancy gained more weight than did pregnant animals only provided with bland laboratory chow. Although comparisons of body weight during pregnancy were not statistically significant, pregnant animals provided with two foods developed more adipose tissue, in the form of large adipose cells, than did pregnant animals provided with only bland laboratory chow. During the postpartum period the body weights of previously pregnant animals were similar to body weights of other groups. However, animals did not lose the excess adipose tissue after delivery of their pups. After pregnancy previously pregnant animals exposed to two foods were still fatter than their nonpregnant controls, and fatter than pregnant animals exposed to only bland food. In the present study, the opportunity to consume sweet-tasting high caloric food while pregnant was accompanied by excess consumption of this food and led to excess body fat gains.

In addition, there were several changes in food consumption both during and after pregnancy. Pregnant rats consumed significantly more bland food during and after pregnancy than did nonpregnant controls. Pregnant rats provided with a glucose solution in addition to bland food consumed more solution than did appropriate controls. The increased caloric need during pregnancy was accompanied by both bland food and sweet-tasting food consumption increases.

During lactation rats provided with two foods ate less bland food than during pregnancy, but maintained their high consumption of the glucose solution. This finding prompts at least two possible explanations. One, the energy requirements for lactation could be satisfied with simple caloric supplementation rather than balanced nutritional

intake. Two, because of increased glucose consumption during pregnancy, rats develop a learned taste preference for sweet foods that continued after the original pregnancy period. It is not possible from the present study to determine if either of these explanations is true. Further studies should manipulate caloric need after pregnancy. If rats not allowed to lactate consume similar amounts of glucose solution compared to rats allowed to lactate, then the caloric need of lactation has little effect on sweet food consumption. It may be deduced that pregnancy can cause a learned taste preference for sweets to develop that could lead to excess weight gains if allowed to control eating behavior.

It is interesting to note that although pregnant rats receiving two foods were fatter than any other groups, the body weights of this group were not statistically different from any other group. Possibly the effect of sweet food consumption on pregnancy-induced body weight gain is subtle and cumulative over pregnancies. The animals in the present study were primiparous, and any effects of consumption changes on excess gains may appear over two or more pregnancies. If adipose tissue gains in the present study are repeated in subsequent pregnancies, multiparous animals would become much more obese than their nulliparous counterparts. This idea needs empirical testing.

Conclusions

The following are hypotheses formed and conclusions drawn for each of the two studies.

Human Study:

1. Time since last menstrual period will be positively related to weight gain for pregnant women.

This hypothesis was correct. Women weighed more in the third trimester than did women in any other pregnancy study period. Women were selected in the present study to be health, normal pregnant and postpartum subjects. Any deviation from normal weight gains could be a sign of too rapid or too slow a rate of weight gain.

2. Total amount consumed in the laboratory session will be positively related to weight gain during pregnancy.

This hypothesis was not correct. Total food consumption did not differ over the course of pregnancy. Total food consumption was not related to weight gain, either normal or excess, for any pregnancy study period. In the present study the time of most rapid weight gain - the third trimester - was not accompanied by an increase in total food consumption over the other two trimesters. Evidently, more rapid normal weight gains do not require increased caloric intake. The possibility still remains that excess gains may be accompanied by excess general food consumption.

3. Sweet food consumption will show the strongest relationship to weight during and after pregnancy as compared with either salty or bland food consumption.

This hypothesis was not correct. Sweet food consumption was not directly related to weight during or after pregnancy in the present

study. However, sweet food consumption was significantly higher in the second trimester, as compared with any study period. This increase in sweet food consumption during the second trimester could indicate a critical time where excess weight gains due to excess consumption of sweet foods might occur.

4. Those women who are gaining excess weight will consume more sweet food in the laboratory than will women who are gaining normal amounts of weight.

This hypothesis was not tested, because of the small numbers of women gaining more weight than predicted in the present study. Even among women who gained more weight than predicted from demographic information, few gained more than 5 pounds in excess of predicted.

5. Assuming that pregnancy is not stressful, prepregnancy levels of restrained eating will be negatively related to any excess weight gains; with increasing levels of restraint before pregnancy less weight will be gained.

This hypothesis was not correct. Levels of restrained eating were not related to weight gain in the present study. However, most women in the present study were relatively restrained in the eating patterns, and also did not gain excess weight. This relatively high level of restraint could have protected women from gaining excess weight by limiting their food consumption outside the laboratory.

6. Previous weight history (weight fluctuation, maximum percent deviation from ideal weight) will be positively related to any excess weight gain during and after pregnancy.

This hypothesis was not tested because of the lack of excess gains for women in the present study.

7. Depression and anxiety levels during pregnancy will be related to any excess weight differences during pregnancy

This hypothesis was not able to be tested, due to the lack of excess weight gain among subjects. However, in the present study affect levels were generally low, suggesting that with a different population this hypothesis may still be true.

8. General stress (obstetrical problems, financial difficulties, etc.) will be positively related to affective differences (depression, anxiety) both during and after pregnancy.

This hypothesis was not correct. In the present study the generally low levels of stress were not related to measures of affect.

9. Social support will be negatively related to affective differences (depression, anxiety) both during and after pregnancy.

This hypothesis was correct. Social support as measured by the ISEL was negatively related to affect measures in the present study. Social support was high in the present study and could have been involved in the low levels of reported stress and affect levels.

Animal Study:

1. Rats will gain weight throughout their pregnancies.

This hypothesis was correct. Rats gained weight throughout their pregnancies.

2. Pregnant rats will consume more glucose solutions than will nonpregnant rats.

This hypothesis was correct. Pregnant rats consumed more glucose solution than did nonpregnant rats. After delivery previously pregnant rats consumed more glucose solution than did controls.

3. Rats receiving glucose solutions and standard chow will gain more weight, store more adipose tissue, and develop larger adipocytes than rats receiving standard chow.

This hypothesis was partially correct. Rats receiving glucose solutions had larger adipocytes than did rats receiving only bland chow. There were no significant body weight differences or total body fat differences between these two groups.

4. Pregnant rats will gain more weight, store more adipose tissue, and develop larger adipocytes than nonpregnant rats.

This hypothesis was partially correct. Pregnant rats contained more fat and had larger adipocytes than did nonpregnant controls. There were no body weight differences between pregnant and nonpregnant rats.

5. Pregnant rats receiving glucose solutions and standard chow will gain more weight, store more adipose tissue, and develop more and larger adipocytes than any other group of rats.

This hypothesis was partially correct. Pregnant rats with two foods stored more adipose tissue than did any other group. There were no body weight or cell number differences between any group.

6. The uterine, subscapular and parametrial fat pads will show the most increase during pregnancy, especially when rats are provided with sweet food. Other pads (abdominal subcutaneous, subscapular) will increase only when rats are provided with two foods and not during pregnancy.

This hypothesis was not correct. In general all pads showed similar patterns of increase during and after pregnancy.

Summary

The present research was an initial investigation into possible reasons for varying patterns of weight gain during and after pregnancy. The human laboratory and the animal studies provided data on behavioral, psychological, and biological variables that change during and after pregnancy. In addition, both studies yielded useful information about the possible causes of excess weight gains associated with pregnancies for some women.

Sweet food consumption could play a role in excessive weight gains associated with pregnancy. Women displayed an increased consumption of sweet-tasting high caloric food, a change in consumption which resulted in change a in caloric intake. This increase in consumption in the laboratory was evidently not indicative of an increase in daily consumption of sweet-tasting foods or of calories because the women in this study did not gain excess weight during or after their pregnancies. Possibly, this dissociation of laboratory and daily food consumption is due to psychological restraint. The women in the present study were relatively restrained eaters and so might not consume excess calories when there was a chance of weight gain. In the laboratory, the idea of "consuming as much of each food as you like" might have influenced these women to decrease their normal restraint and allowed them to eat as they preferred. The laboratory measurement of food consumption might be sensitive to changes in food preference, while other variables would interfere with consuming what one wishes in daily life.

It is reasonable to assume that there are a minimal number of cognitive variables that could affect food consumption and weight gains

in rats. This rat model of human pregnancy can provide information about behavioral contributions to differential weight gains that is relatively free of psychological influences, such as cognitive restraint. The lack of restraint may have enabled rats in this study to consume sweet food freely during and after pregnancy, and so provide an illustration of changes in food consumption with minimum cognitive interference. If this is true, then populations of humans with low restraint should consume more sweet food as part of their daily eating habits and so gain excess adipose tissue during and after pregnancy.

The changes in sweet preference occurred during the second trimester of pregnancy in humans. The second trimester is a time in pregnancy when normally the mother is beginning to gain appreciable amounts of weight, particularly in the maternal compartments, such as adipose tissue. Because of psychological and/or biological reasons, some women may be vulnerable to consuming more sweet-tasting foods when they experience this sweet preference change, and so would gain more weight. Possibly previous pregnancies could predispose women to have larger or more long-lasting preferences for sweet-tasting high caloric food during pregnancy. This proposal needs empirical validation.

The animal study can be considered as a model of the biological and behavioral changes that occur during and after pregnancy. Based on data from the animal study, sweet preferences that occur during human pregnancy can lead to excess adipose tissue gains. Pregnant and previously pregnant animals provided with a choice of two foods--a bland nutritious laboratory chow and a sweet-tasting high caloric food--ate more sweet-tasting food during and after pregnancy than did controls. Concurrent with this change in consumption was an increase in body fat

at several fat depots. The causal relationship between these two variables was unclear from the present study. Wade (1979) has argued that the gonadal steroids, specifically estrogen and progesterone, cause enzymatic changes in the membrane of adipose tissue. These biological changes then lead to increases in food consumption. Increases in food consumption, if prolonged over a period of time, cause increases in body fat and body weight. Possibly a similar process is involved in weight gains that accompany pregnancy, since gonadal steroids are maintained at a high level during pregnancy. Future studies should address the question of the specific biological mechanisms involved in excess pregnancy-associated weight gains in animals and any connections with human situations.

Pregnant animals provided with two foods in the present study showed an increase in adipose tissue, but not in body weight. As previously mentioned, the animals were primiparous, and any effects of food consumption on weight gains may be cumulative over two or more pregnancies. A similar pattern of body fat and body weight gain may be found in humans. Possibly, with the first pregnancy women gain excess adipose tissue that does not translate into a significant or noticeable increase in body weight. Over the course of multiple pregnancies, however, the adipose tissue gains may accumulate and women may actually gain excess weight. This hypothesis could be tested in animals by comparing adipose tissue and weight gains over several pregnancies. Alternatively, behavioral and psychological variables of multiparous and primiparous women could be compared during and after pregnancy to determine their relative contribution to excess fat and weight gains.

The patterns of affect and other psychological variables found in the human study may be specific to the particular population of women sampled. These variables may be responsible for the relationship between changes in taste preferences and actual food consumption and weight gain during and after pregnancy. To the extent that psychological variables are involved in food consumption and weight gains associated with pregnancy, further studies should address the issue of differing levels of stress, affect, and restraint in other samples. These differences might be found in low-income populations and in women who are experiencing acute or chronic stressors during and/or after pregnancy.

An area that has not been thoroughly investigated is the effect of excess maternal weight and fat gains on infant adipose tissue and food consumption. For example, infants of mothers who gain excess weight may be at risk for gaining too much adipose tissue themselves because of placental transfer of nutrients. The relationship between maternal and fetal glucose levels is approximately 1:1. If women consume too much sweet-tasting high caloric food, the fetus could be exposed to higher-than-normal glucose levels in utero. This increased exposure, especially in a sensitive developing organism, could predispose an infant to poor metabolic control in childhood or adulthood. Possibly this infant would be at risk for the development of obesity because of the increased prenatal exposure to glucose.

In conclusion, the present studies have suggested areas of further research into the reasons for both normal and excessive weight gains associated with pregnancy. Animal models of behavioral and biological factors that could play a role in these weight gains are

needed. In humans, the relationship among preference changes, psychological variables, and acute eating behavior deserves further research.

Footnotes

¹ Thirty-eight nonpregnant women, of comparable age and background to women who participated in this research, were run in a food-tasting study that served as a pilot to develop these procedures.

² In addition to analysis of the food consumption data as grams of food consumed, consumption of each food was divided by total amount consumed and multiplied by 100 to obtain the percent of each food consumed. This analysis controlled for varying amounts of food consumed by each woman. When analyses of variance were performed on percent sweet, salty, and bland food eaten, the results were very similar to those obtained using absolute amounts of each food class consumed. The correlation between percent of sweet food consumed and absolute amount of sweet food consumed was $r = 0.89$, $p < 0.001$.

³ These assays were performed under the supervision of Dr. Irving Faust of Rockefeller University.

⁴ An alternative method of statistical analysis for the biological data would be the multivariate analysis of variance (MANOVA). This statistical method has the advantage of calculating the variance shared by several dependent variables, as in the case of several fat depots from the same animals. However, for two reasons univariate analyses of variance are used in the present study. One, different hypotheses about particular fat depots require separate analyses of variance. Two, the complexities of the MANOVA are currently beyond the scope of the investigator.

Acronym Key

MAACLT-total scale score for Zuckerman affect scale
 MAACL1-anxiety subscale score
 MAACL2-depression subscale score
 MAACL3-hostility subscale score
 ISELT-total scale score for social support scale
 ISEL1-appraisal support subscale score
 ISEL2-belonging support subscale score
 ISEL3-tangible support subscale score
 ISEL4-self-esteem support scale score
 STUNKT-total scale score for Stunkard eating scale
 STUNK1-cognitive restraint subscale score
 STUNK2-hunger subscale score
 STUNK3-weight lability subscale score
 HP-score for Herman and Polivy restraint scale
 BECK-score for Beck Depression Inventory
 TOTSTR-score on questions on current stress level
 BMI1-body mass index at time of study
 BMI2-body mass index at time of first obstetrical visit
 FAT-percent body fat at time of study
 SWATE-grams of sweet food eaten in laboratory
 SAATE-grams of salty food eaten in laboratory
 BLATE-grams of bland food eaten in laboratory
 TTATE-grams of total food eaten in laboratory
 INDEX-study weight-first obstetrical weight
 week of pregnancy

NOTE: The average number of subjects used to compute each
 correlation was 45.

Table 1. Demographics of Human Subjects During Study Periods

	Study Period				
	<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>pl</u>
	(n=11)	(n=15)	(n=12)	(n=12)	
<u>AGE (X)</u> ^b	28.3	26.1	28.1	30.6	ns
<u>PARITY:</u> ^a					
Primiparous	4	7	6	7	
Multiparous	7	8	6	5	ns
<u>INCOME (X)</u> ^b	38,500	41,000	48,000	43,500	ns
<u>EMPLOYMENT:</u> ^a					
Yes	8	14	12	11	
No	3	1	0	1	ns
<u>BMI</u> ^b	0.0345	0.0353	0.0362	0.0327	ns
(from first obstetrical weight)					

^a chi square analysis used

^b analysis of variance used

Table 2. Correlation Matrix of Questionnaire Measures

	MAACL1	MAACL2	MAACL3	MAACLT	ISEL1	ISEL2	ISEL3	ISEL4	ISELT	STUNK1	STUNK2	STUNK3	STUNKT	HP	BECK	TOTSTR
MAACL1	-	.17	.05	.76**	.05	-.19	-.38*	-.28	-.23	.16	-.09	-.07	-.01	.09	.90**	.23
MAACL2	-	-	.54**	.72**	-.40**	-.48	-.39*	-.42**	-.52**	-.38**	.30	.33**	.14	.02	-.20	.23
MAACL3	-	-	-	.59**	-.15	-.26	-.24	-.36*	-.31*	-.10	.25	.18	.17	.27	-.02	-.04
MAACLT	-	-	-	-	-.19	-.40**	-.48**	-.47**	-.46**	-.09	.14	.15	.10	.15	.59**	.27
ISEL1	-	-	-	-	-	.62**	.60**	.30*	.78**	.36	.24	-.20	-.06	-.06	-.12	-.32*
ISEL2	-	-	-	-	-	-	.69**	.53**	.87**	.36	-.11	-.17	.02	-.01	-.02*	-.27
ISEL3	-	-	-	-	-	-	-	.59**	.85**	.20	-.13	-.13	-.04	-.24	-.32**	-.18
ISEL4	-	-	-	-	-	-	-	-	.74**	.20	.18	.09	.22	.22	-.16	-.01
ISELT	-	-	-	-	-	-	-	-	-	.35**	-.09	-.14	.03	-.01	-.09	-.24
STUNK1	-	-	-	-	-	-	-	-	-	-	.16	-.12	.47	.39**	.23	-.05
STUNK2	-	-	-	-	-	-	-	-	-	-	-	.75**	.91	.73**	-.15	.27
STUNK3	-	-	-	-	-	-	-	-	-	-	-	-	.76	.48**	-.18	.28
STUNKT	-	-	-	-	-	-	-	-	-	-	-	-	-	.75**	-.05	.25
HP	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.14	.27
BECK	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	.05
TOTSTR	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

**p < 0.01

*p < 0.05

Table 3. Correlation Maxtrix of Questionnaire, Behavioral, and Physical Variables

	BMI1	BMI2	FAT	SWATE	SAATE	BLATE	TTATE	ISELT	MAACLT	HP	STUNKT	TOTSTR	INDEX
BMI1	-	.90**	.46**	-.02	.30*	.19	.22	-.08	.12	.62**	.52**	.22	.60**
BMI2	-	-	.58**	-.04	.21	.20	.15	-.01	.20	.64**	.60**	.31*	-.25
FAT	-	-	-	-.02	.08	.16	.08	.15	.15	.28*	.25*	-.01	.01
SWATE	-	-	-	-	.31*	.22	.74*	.00	.02	.05	-.04	.33*	.08
SAATE	-	-	-	-	-	.27	.80**	-.15	-.10	.17	.15	.09	-.17
BLATE	-	-	-	-	-	-	.58**	-.18	-.10	.09	.15	.29*	-.20
TTATE	-	-	-	-	-	-	-	-.14	-.08	.14	.11	.30*	-.20
ISELT	-	-	-	-	-	-	-	-	-.46**	-.01	.03	-.24	.09
MAACLT	-	-	-	-	-	-	-	-	-	.15	.10	.11	.15
HP	-	-	-	-	-	-	-	-	-	-	.76	.22	-.10
STUNKT	-	-	-	-	-	-	-	-	-	-	-	.24	-.09
TOTSTR	-	-	-	-	-	-	-	-	-	-	-	-	.12
INDEX	-	-	-	-	-	-	-	-	-	-	-	-	-

**p < 0.01

*p < 0.05

FIGURE 1. SWEET FOOD CONSUMPTION

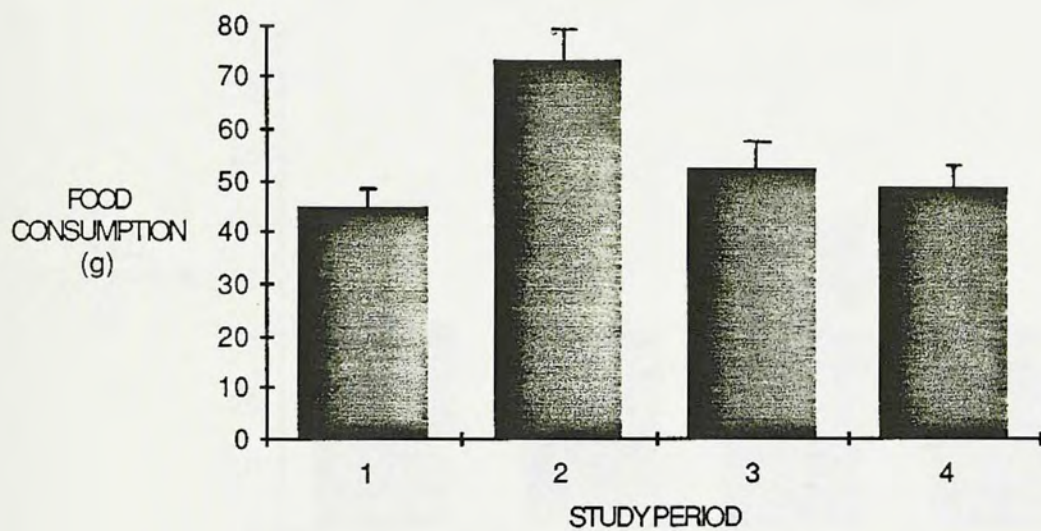


FIGURE 2. SALTY FOOD CONSUMPTION

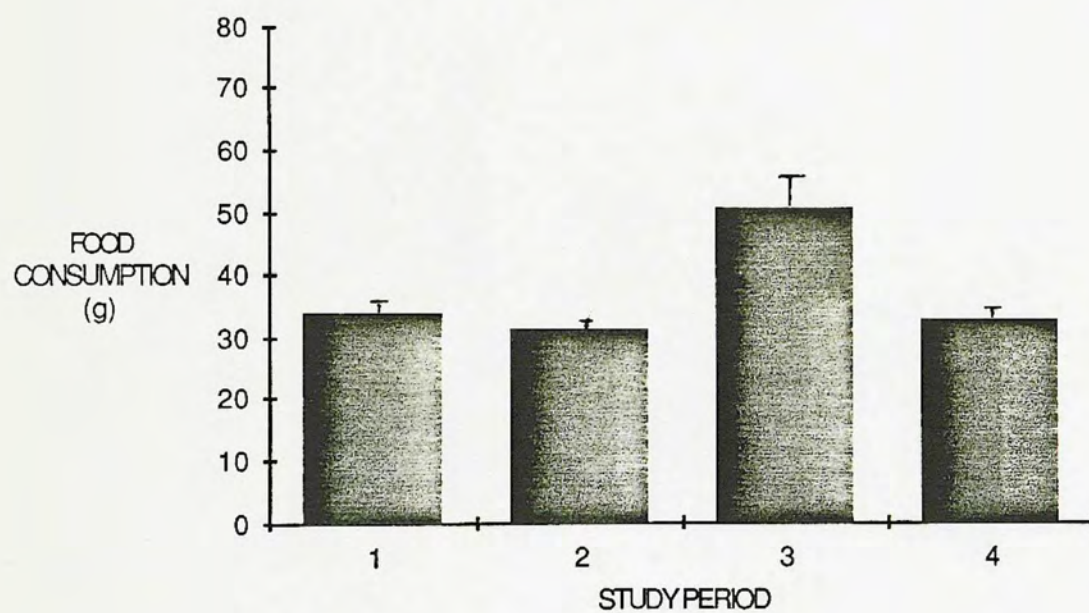


FIGURE 3. BLAND FOOD CONSUMPTION

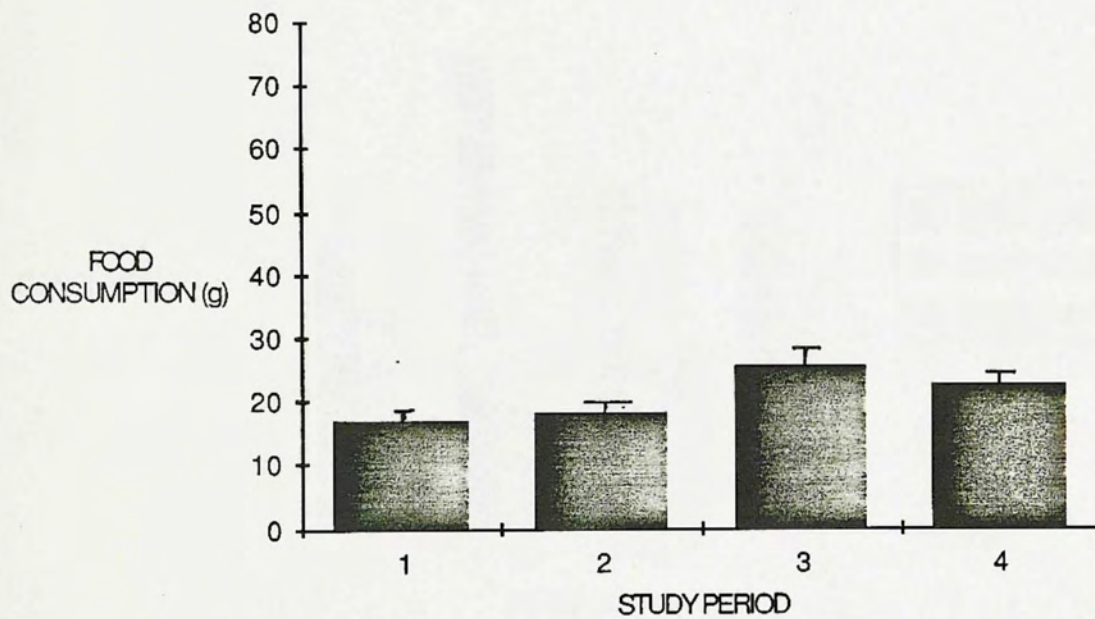


FIGURE 4. CONSUMPTION BY TASTE CLASS

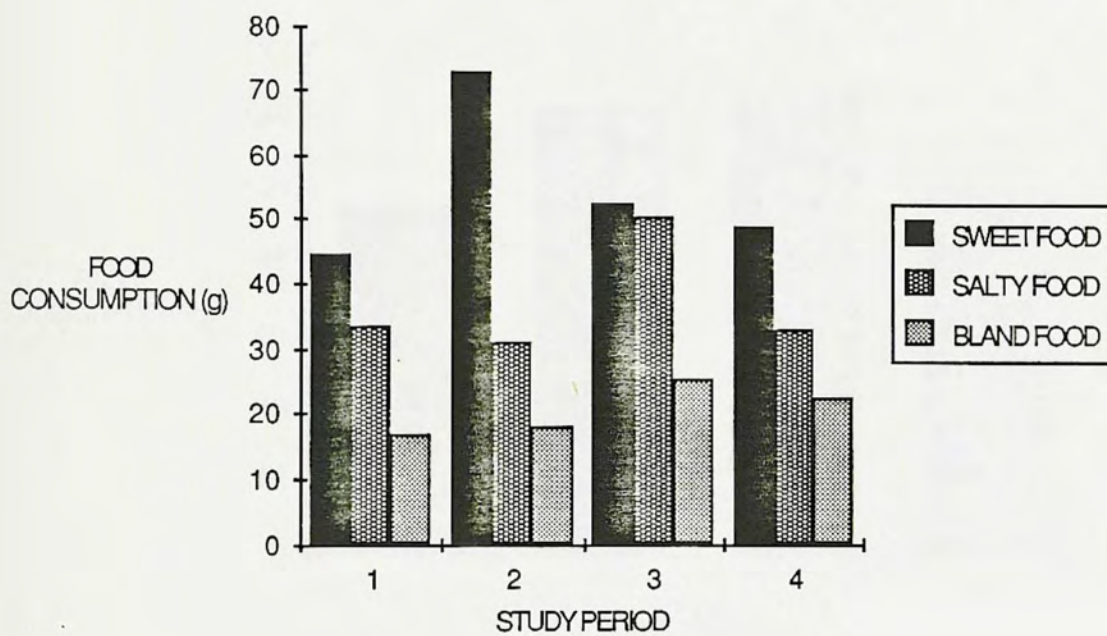


FIGURE 5. TOTAL FOOD CONSUMPTION

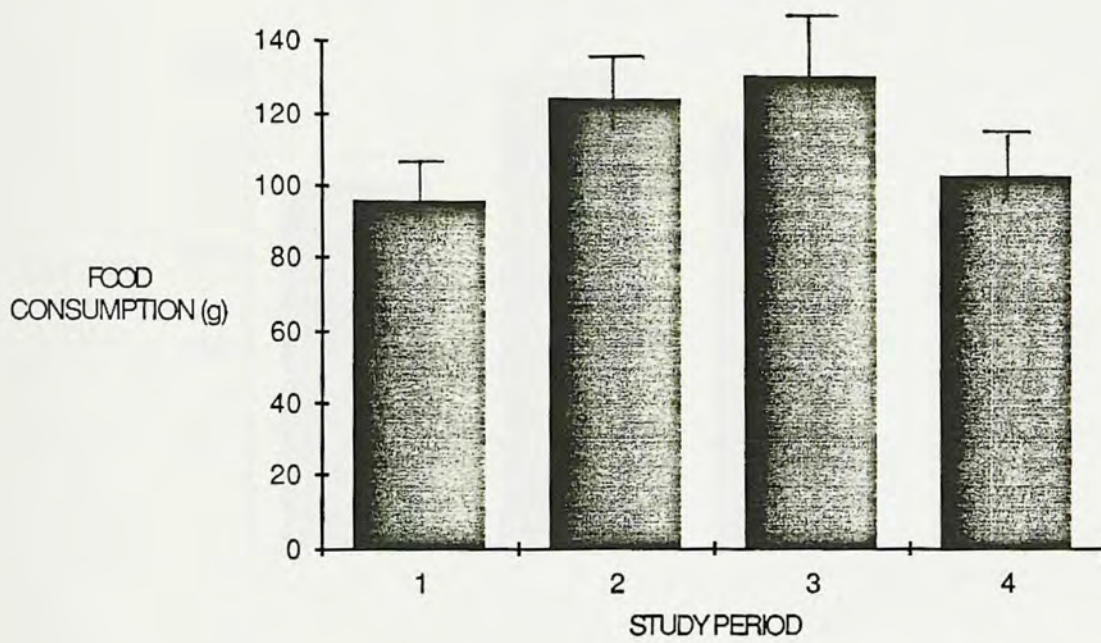


FIGURE 6. TOTAL CALORIE CONSUMPTION

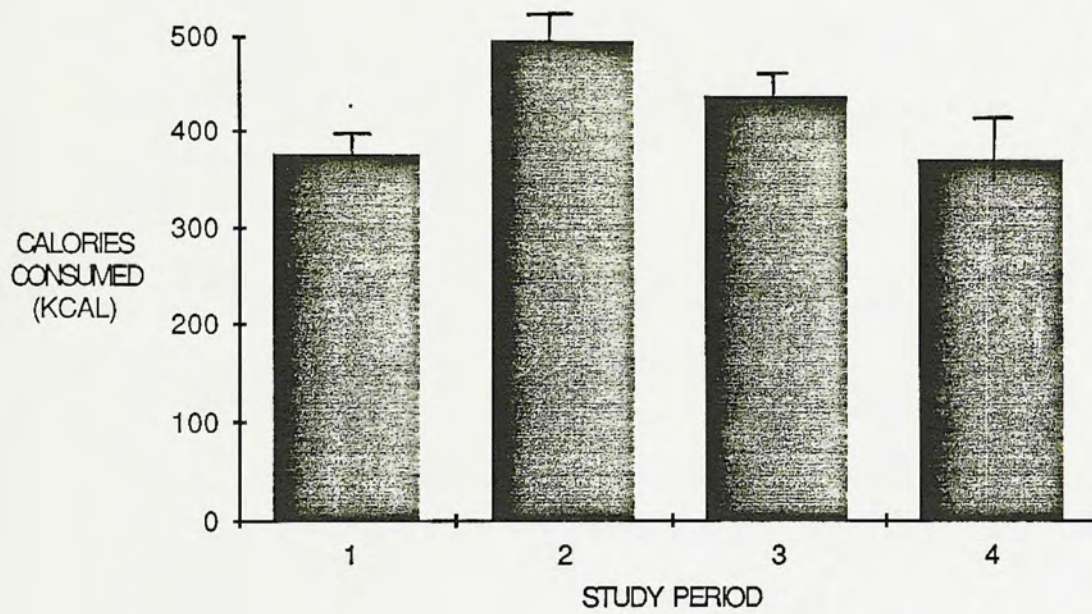


FIGURE 7. SWEETNESS OF SWEET FOODS

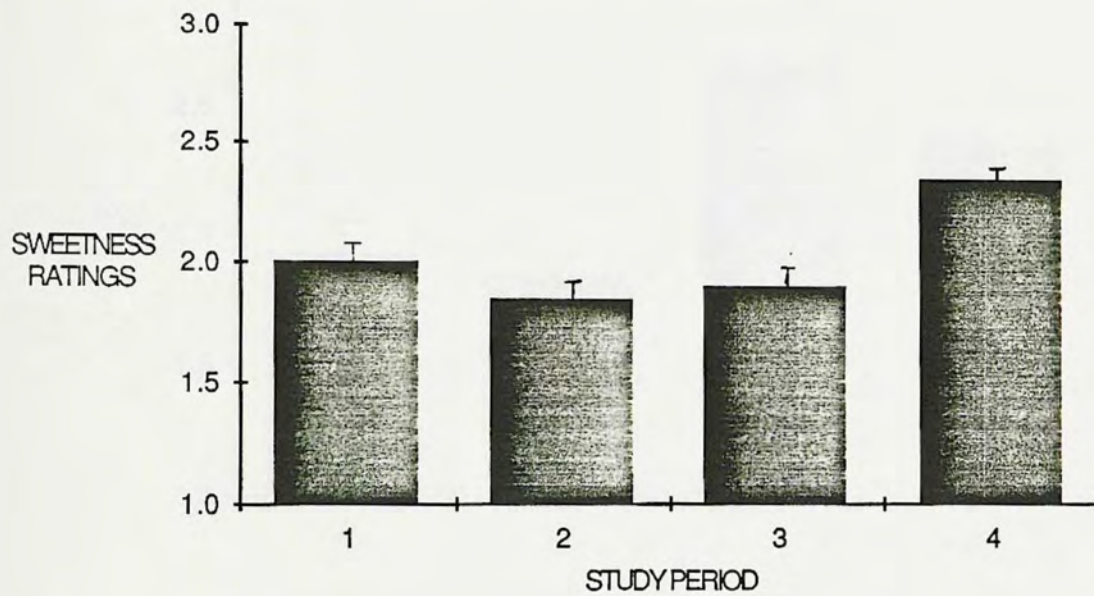


FIGURE 8. SALTINESS OF SALTY FOODS

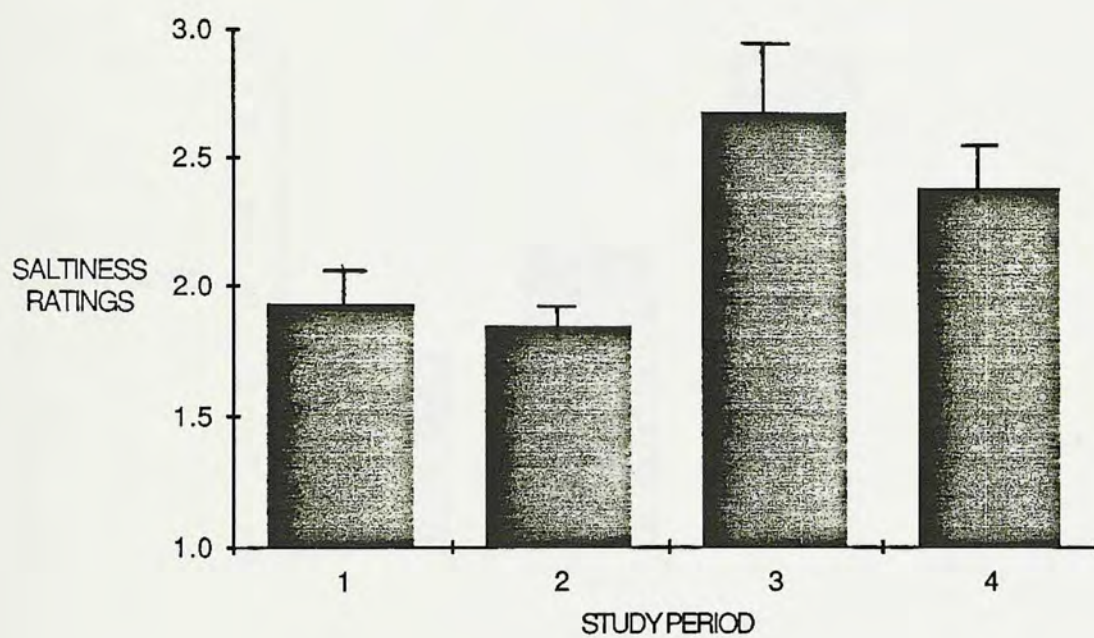


FIGURE 9. WEIGHT GAIN AT TIME OF STUDY

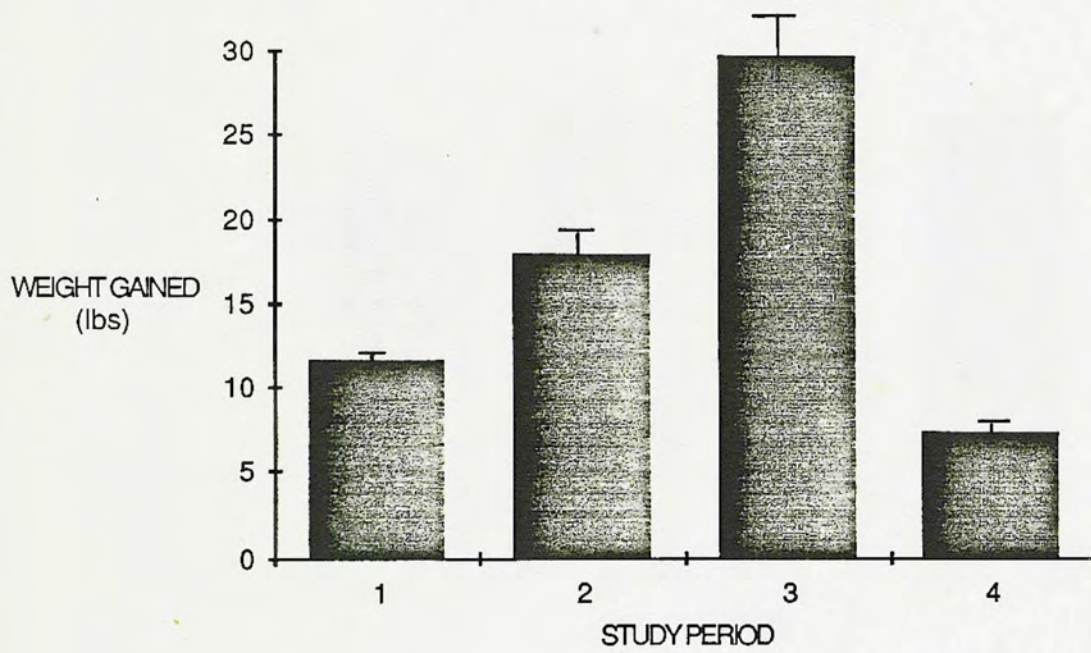


FIGURE 10. % BODY FAT AT TIME OF STUDY

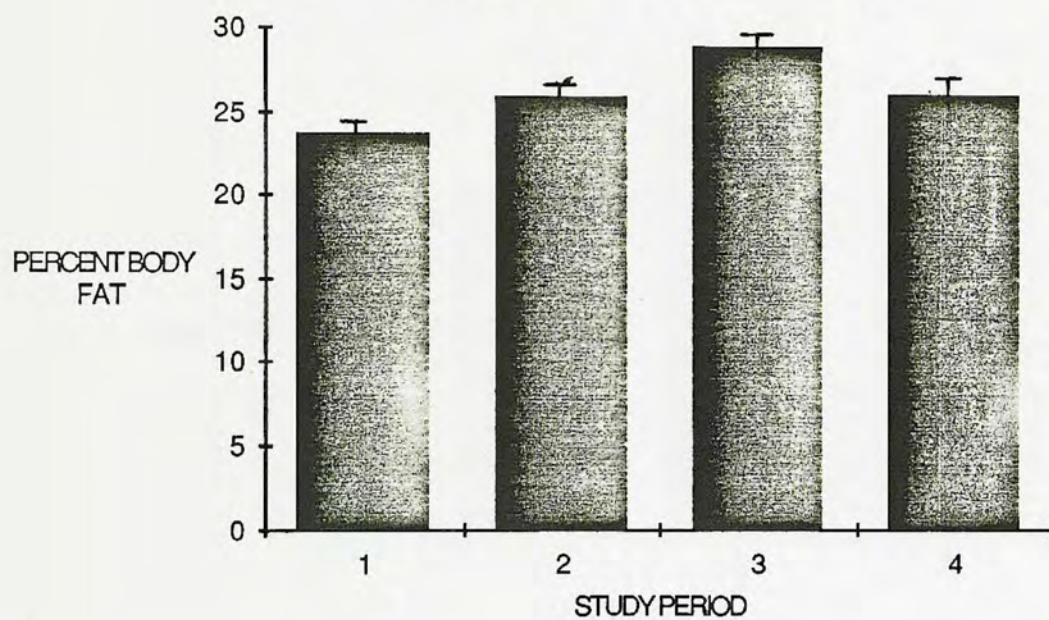


FIGURE 11. BMI-AT TIME OF STUDY

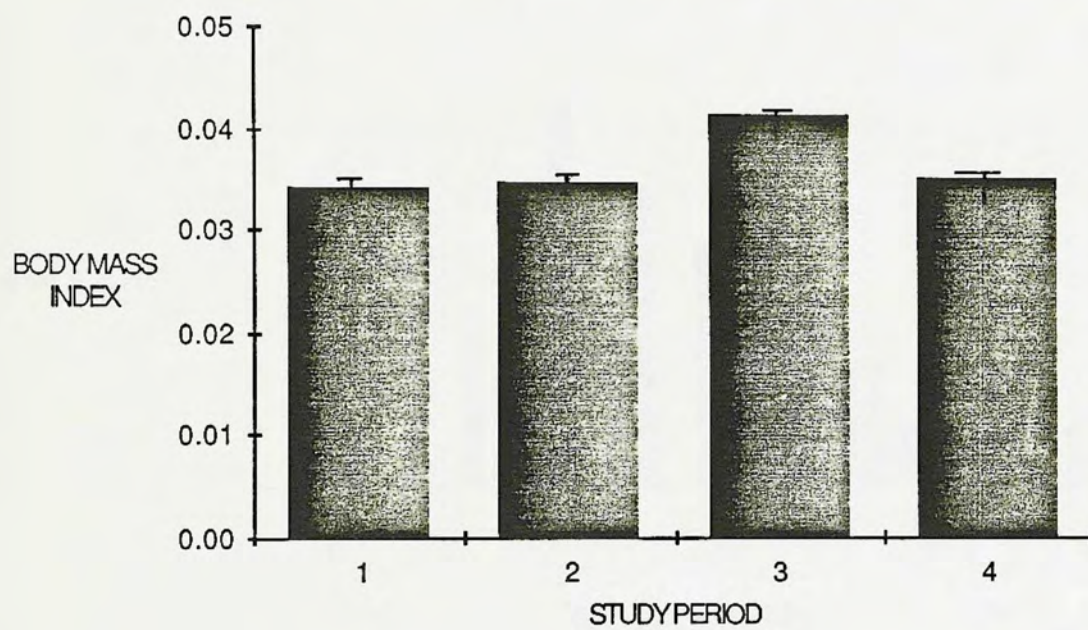


FIGURE 12. FREQUENCY DISTRIBUTION OF SUBJECTS

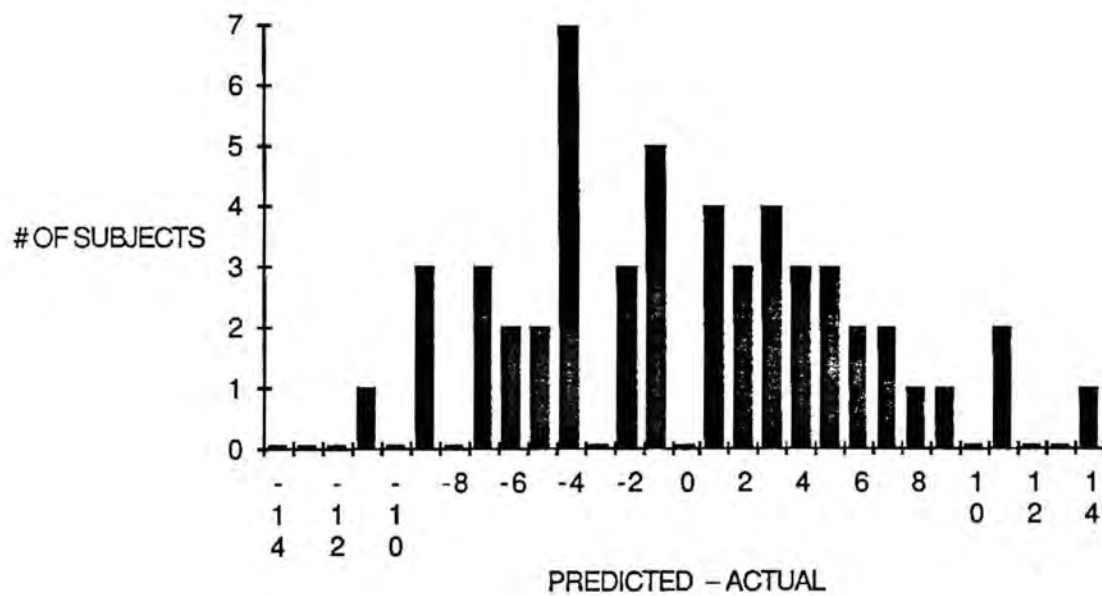


FIGURE 13. BODY WEIGHTS -- ANIMAL STUDY

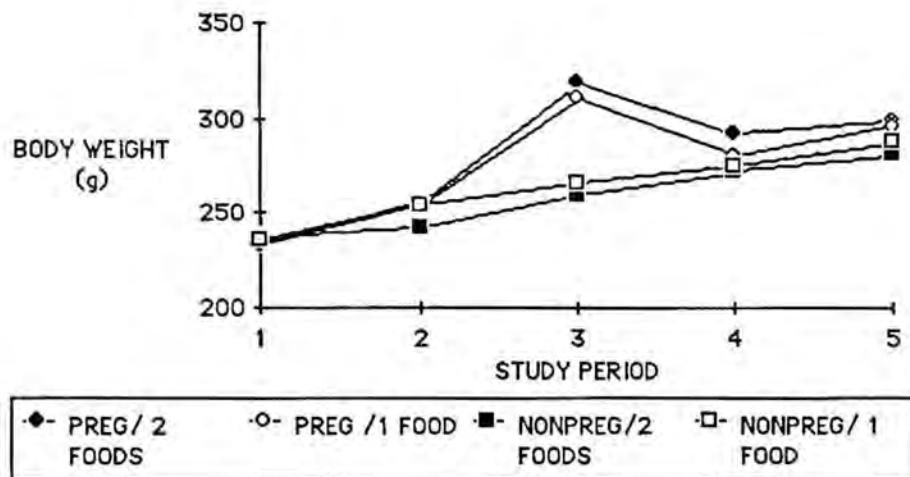


FIGURE 14. BLAND FOOD CONSUMPTION -- ANIMAL STUDY

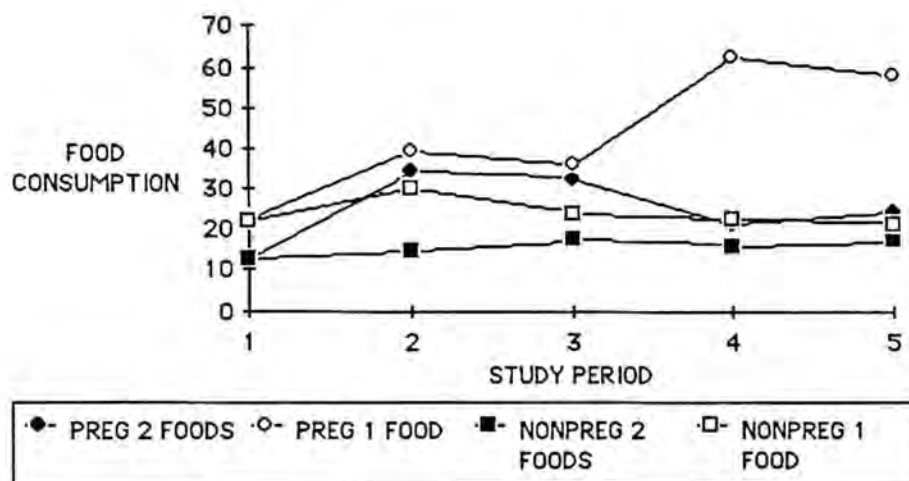


FIGURE 15. GLUCOSE CONSUMPTION -- ANIMAL STUDY

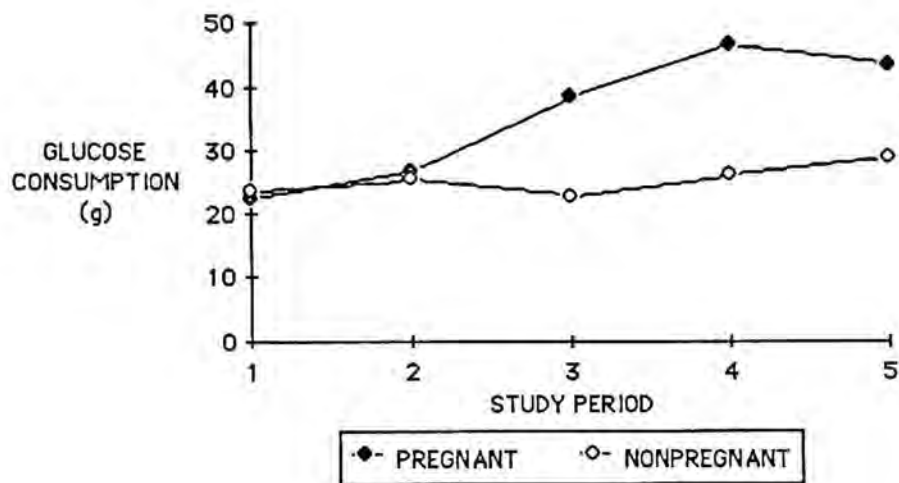


FIGURE 16. WATER CONSUMPTION -- ANIMAL STUDY

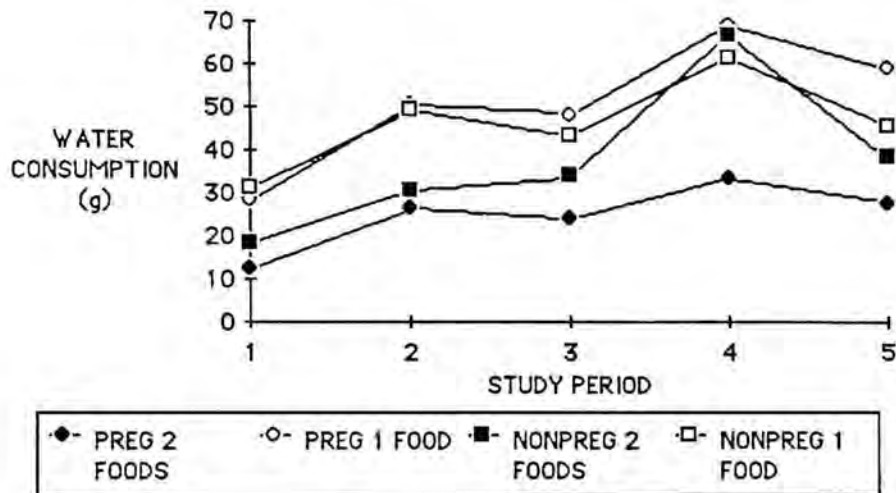


FIGURE 17. TOTAL ADIPOSE TISSUE

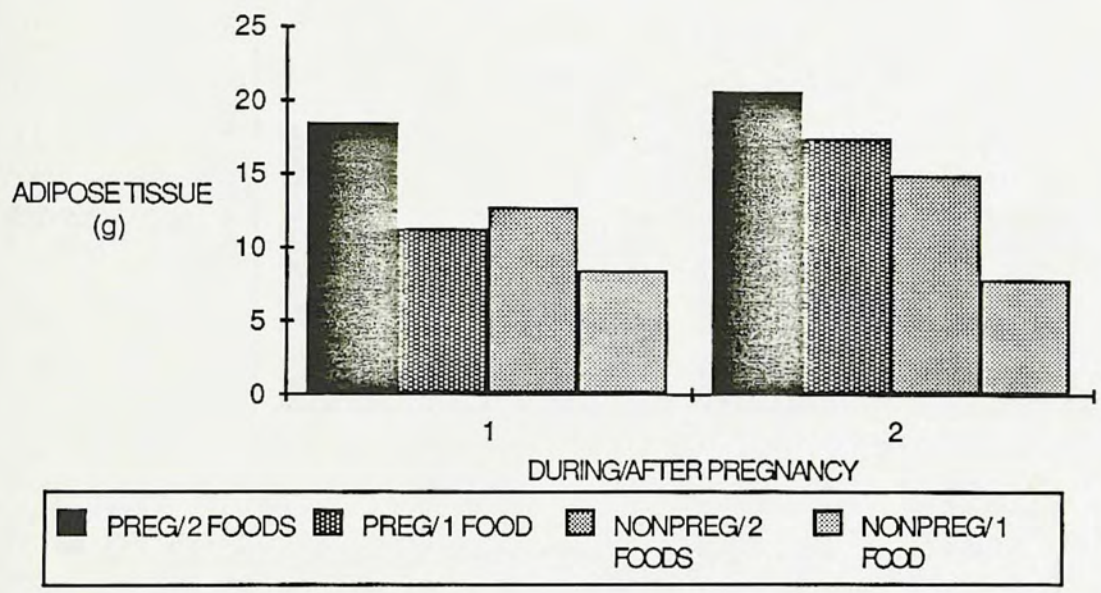


FIGURE 18. PARAMETRIAL PAD WEIGHTS

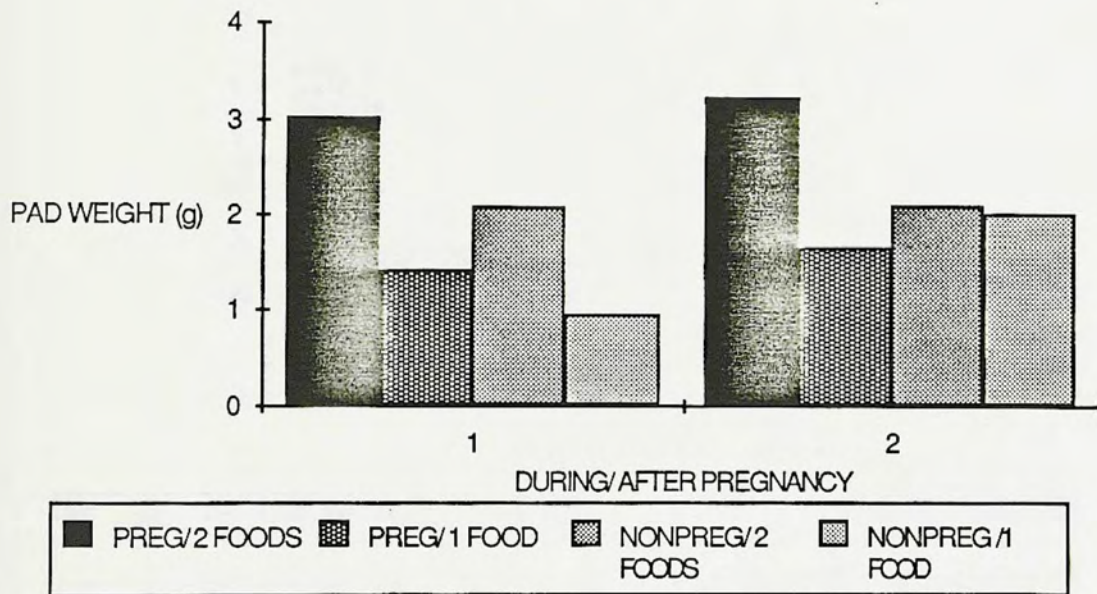


FIGURE 19. UTERINE PAD WEIGHTS

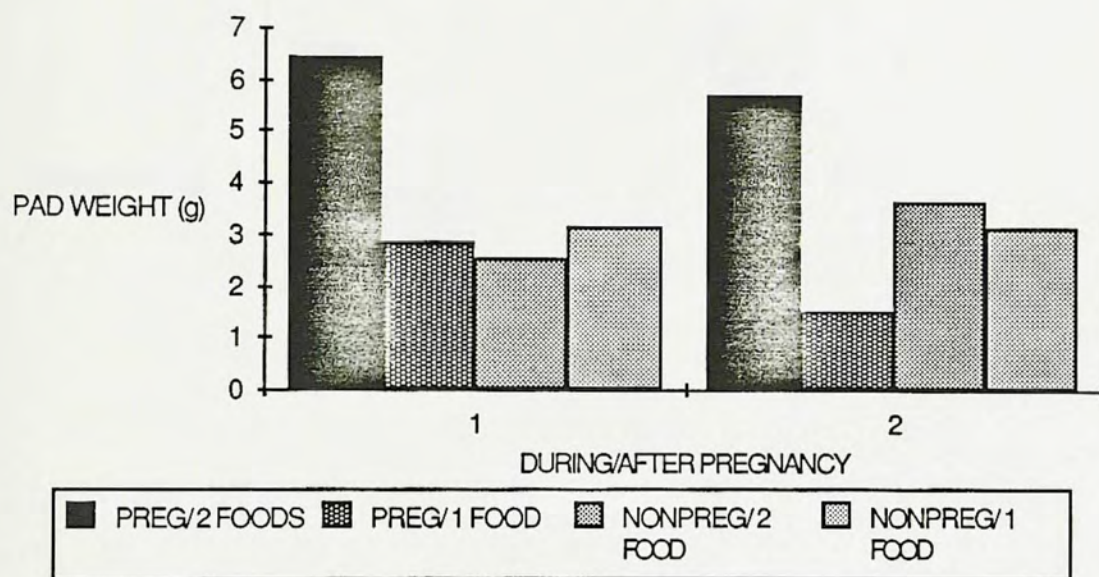


FIGURE 20. ABDOMINAL SUBCUTANEOUS PAD WEIGHTS

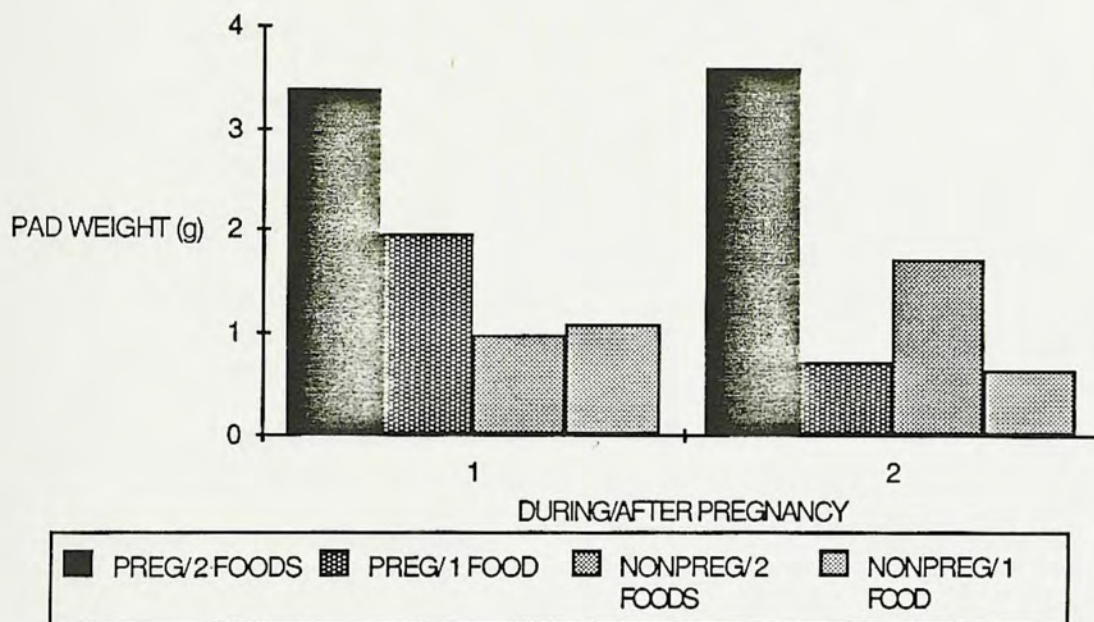


FIGURE 21. SUBSCAPULAR PAD WEIGHTS

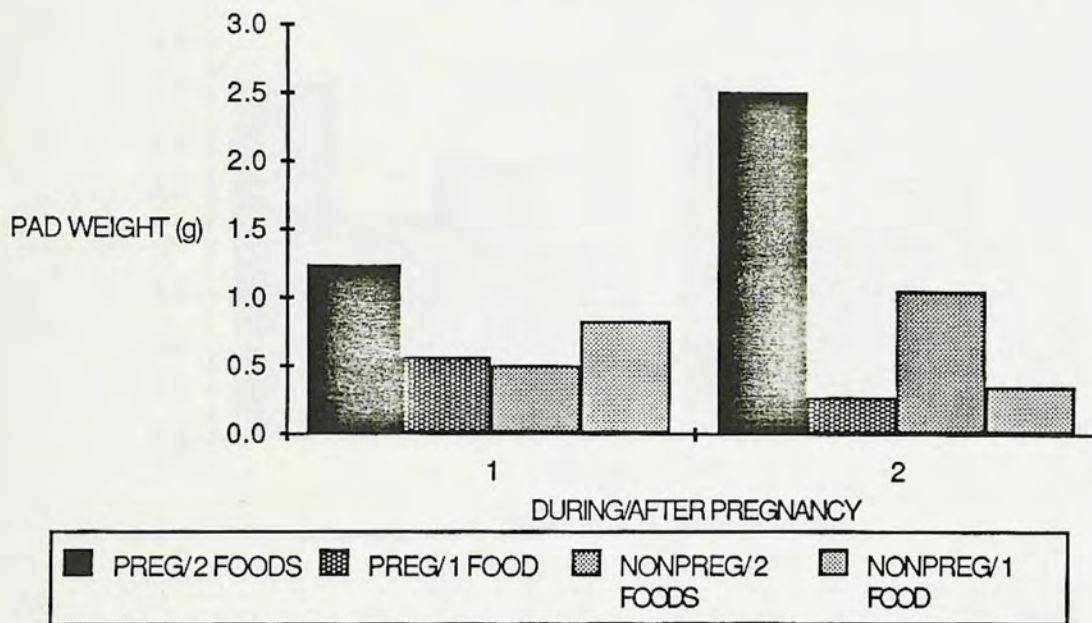


FIGURE 22. PARAMETRIAL CELL SIZE

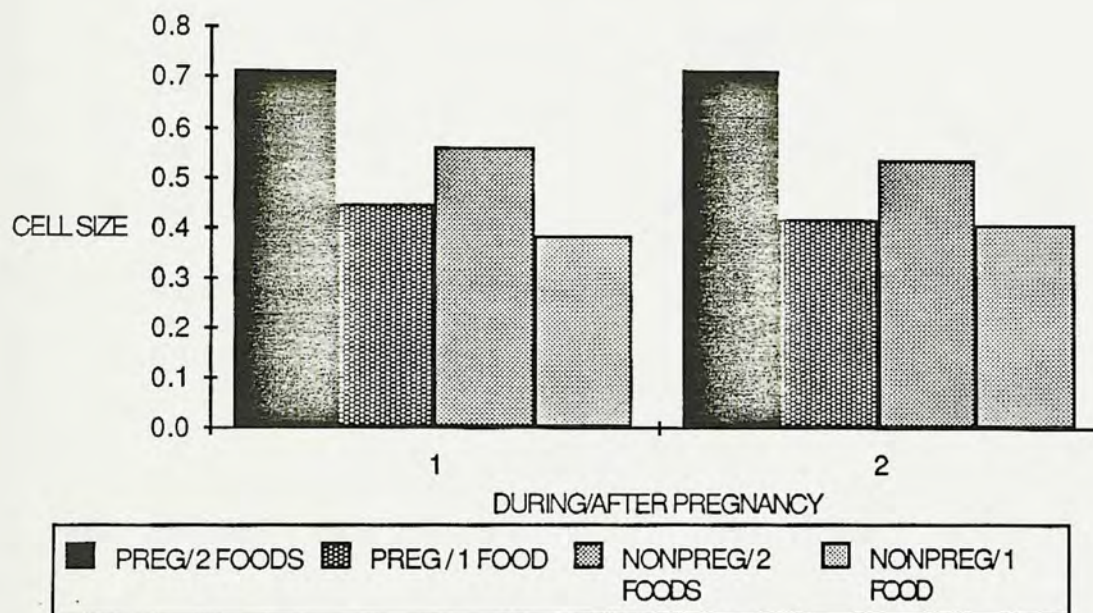


FIGURE 23. SUBSCAPULAR CELL SIZE

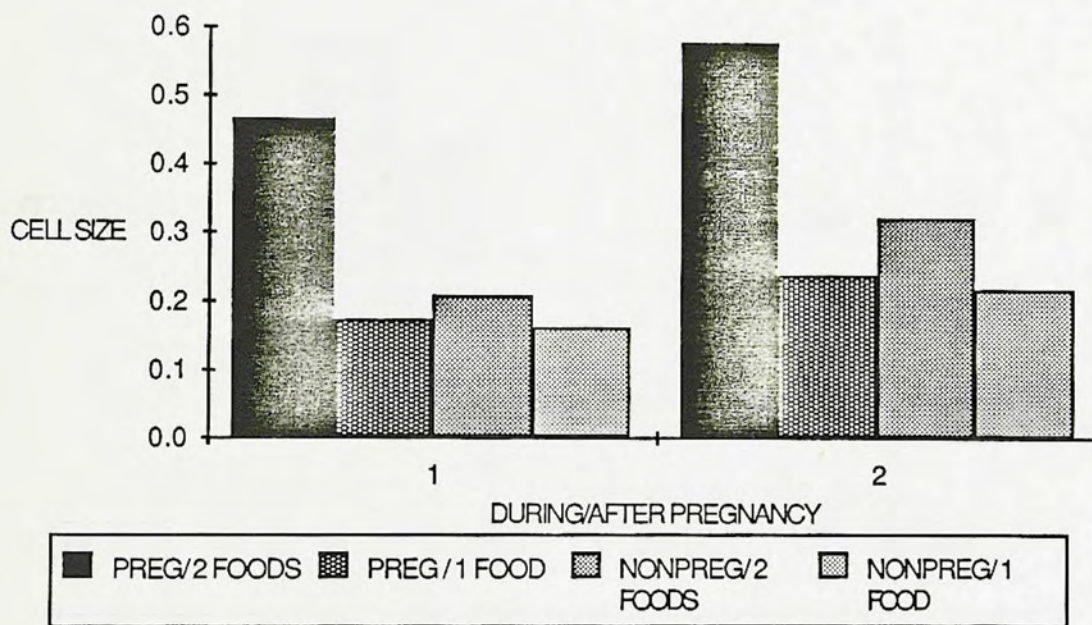
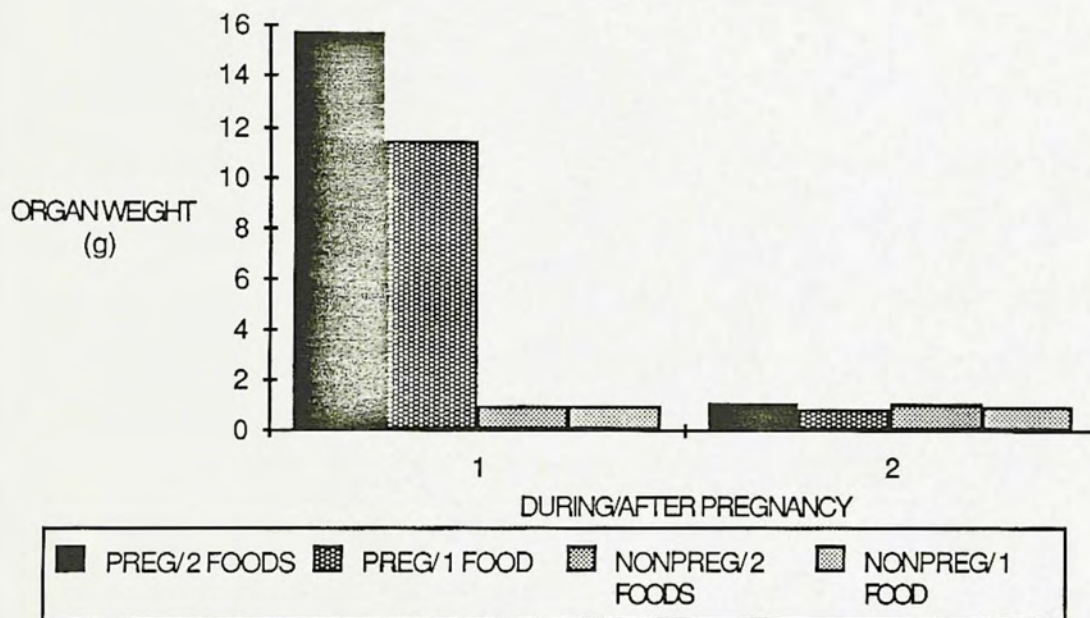


FIGURE 24. REPRODUCTIVE ORGAN WEIGHTS



Appendix A: Experimental Materials for Human Study

Initial Interview

Script

Data Sheet

Types and Brands of Foods

Food Weight Record

Food Ratings

Initial Interview

Hi, this is Debbie Bowen from the Department of Medical Psychology at USUHS. Are you calling about being a subject in a study of sensation and perception during and after pregnancy? Good--let me tell you a little more about it. You would come in for approximately one hour to fill out some questionnaires and to participate in a study of sensory perception. For example, you might listen to sounds, look at some pictures, or taste some foods. We will be taking simple physical measures such as weight and height. You would be paid \$20. Our research facility is located at the U.S. Medical School in Bethesda, MD. How does that sound? Good, then let me get some more information from you.

1. Name _____ Phone # _____
 Best times to reach you _____
 Sex _____ Age _____
2. Do you have any major health problems? _____
 a. Do you have any hearing problems? _____
 b. Do you have any vision problems? _____
 c. Do you have any food allergies or special dietary restrictions? _____
3. Has your obstetrician informed you of any complications in your pregnancy? _____
4. Do you take any medications on a regular basis? _____
5. Do you smoke? _____ Are you an ex-smoker? _____ When did you quit? _____
6. What is your marital status (single, married, other)? _____
7. We run this study at either 4, 5, 6, or 7 p.m. Could you come in at any of those times? Which would be best? _____

I need to coordinate with the other researchers at our facility. We will be calling you back in the next few days to arrange an appointment. Thanks, I'll talk to you later.

SCRIPT

Hi, are you _____ (subject's name)? I'm Debbie Bowen from the Department of Medical Psychology. We have to go upstairs to our laboratory for the study--let's take the elevator over here. Did you have any trouble getting here? (E walks with S through University to experimental suite, making small talk about university, etc.)

(E leads S to suite and gestures for S to sit in hallway. E sits next to S.) First of all, I'd like to thank you for coming in today. We appreciate your help in the study.

We're investigating the relationship among pregnancy, personality characteristics, and sensory perception. You've probably noticed that at certain times your five senses seem to function differently than at other times. For instance, sometimes noises sound louder or softer than at other times, even when you know that the intensity of the sound probably is unchanged. Sometimes foods taste different; you may find that your food needs extra large amounts of salt, or that sweets taste particularly good, or that plain foods taste best. Well, these changes in sensory perception that each person experiences may help to explain differences in perception between different people. In other words, individual differences in perception may depend, to some extent, on differences in biological activity between people. That's why we are asking pregnant women to participate in this study. Pregnancy alters your biological activity, and could cause differences in perception. Also, differences in perception may depend on different personality

characteristics. The experiment that you will participate in today is designed to examine these factors.

In this experiment, you will be examined on at least one of your sensory modalities, you will fill out some questionnaires, and I'll make some physical measurements: your height, your weight, and some other physical parameters. Before we get going though, here's a form for you to sign (E hands S consent form) to show that you agree to be in this experiment. Basically, it tells you what I've just told you, but you should read it over carefully anyway. Please sign it at the bottom when you're through.

(E takes signed consent form, gives S a copy, and leads S into experimental suite lobby.) Here we have several rooms set up to test for sight, sound, and taste. (E gestures to experimental rooms.) We don't have time to run you through all three conditions today. (E glances at table of conditions.) You're in the taste condition. You'll taste some standard everyday foods and rate them on taste judgment sheets. Let's go to the taste testing room (E leads S to experimental tasting room and gestures for S to sit in chair). Have a seat here. As you can see, in front of you are nine different foods for you to taste (While speaking E uncovers foods one by one, then sits next to S). We'd like you to taste each food in order and then describe how it tastes to you by rating each food on this set of basic taste dimensions. What I mean is, start out with Food #1 and taste it thoroughly. Then on the sheet marked #1, rate the food on these taste dimensions by circling a number from 1 to 7 depending on how the food tastes on each dimension. For example, if Food #1 tastes extremely sour, circle #1, and if it tastes not at all sour, circle #7 (E points to appropriate parts of the

page). If you think it's somewhere in between, circle the number that most closely corresponds to your judgment. Only circle numbers--don't circle words. Rate Food #1 on all the dimensions. After you completely finish rating Food #1, take a drink of water to rinse out your mouth, then move on to Food #2 and Sheet #2. (E moves Sheet #1 and points to Sheet #2.) Continue in order for each of the 9 foods. (E pauses and looks directly at S.) It's important that your ratings are as accurate as possible; so, eat as much of each food as you want in making your judgments. After you've finished rating the foods feel free to go back and eat as much as you want of any of the foods, but please be sure you've rated everything first. (E stops, then as if making a casual, friendly comment, continues.) I'm going to have to throw these foods out anyway after you finish, so you might as well eat what you want. Do you have any questions? So after I leave you'll taste each food in order and rate it on each dimension. Then after you've finished all the tasting, eat what you want of any of the foods. Okay, I'll be back in a while to see how you're doing. If you finish before I get back, just sit tight and relax. (E turns to leave, and opens the door to the room.) Have fun! (E leaves.)

(E returns after 20 minutes.) Okay, are you finished? I'll take the rating sheets. We've finished the taste rating part of the study now. One more question before we go. Please tell me--of the nine foods you tasted today, which were your three favorite in order? (E records choices of S on data sheet.) Okay, come on into the other room to fill out some questionnaires. (E leads subject into Room A where there is a pile of questionnaires on the table.) Please have a seat (E explains questionnaires). I'll come back to check on how you're doing. If you

finish early, just knock on the door and that will get my attention. (E leaves room.)

All finished? Okay, let's step out into the hallway to get your height and weight (E leads S out of the room to the scale). Please step up onto the scale. We have to weigh everyone on the same scale because we need a consistent measure for everyone. You don't have to take off your shoes. Everyone's weight is a little high on this scale, and your shoes weigh a few pounds. (Experimenter records weight.)

Now step down from the scale, and step back up with your back to the wall so that I can measure your height. Okay, that's the position. Thanks, you can step down (E records height.).

Let's go back into the experimental room so that I can finish the measurements. The last measurement that I will take is the thickness of your skin on your arm and abdomen. (E shows S skinfold calipers.) This is another measure that differs among women who are pregnant. Please roll up your sleeve so that I can measure your skin. (E measures skinfold thickness with calipers.) Now please lift up your shirt so that I can measure the skin on your abdomen. (E measures skinfold thickness on abdomen.) Thanks, that's all that I need from you. One more thing. Here's a receipt for you to sign so that I can pay you. Here's your payment (E collects receipt and pays subject.). Do you have any questions about the study? (E then debriefs S. After S is debriefed, E shows S to door).

DATA SHEET

Subject # _____

Date _____

Time _____

Condition _____

Race _____

Height _____

Weight 1 _____ BMI1 _____
at study

Water in _____

Weight 2 _____ BMI2 _____
last GYN visit

Water out _____

Total Water Drunk _____

Weight 3 _____ BMI3 _____
first OB visitSkinfold _____
_____Three foods _____

MAACK Dep _____

Herman _____

Cohen

Anx _____

1. TAN _____

Host _____

Stunkard

2. APP _____

Beck _____

1. CR _____

3. SE _____

2. LAB _____

4. BEL _____

3. HUN _____

Types and Brands of Foods

Chocolate:	Hershey's Milk Chocolate
Coffee Cake:	Sara Lee Pecan All Butter Coffee Cake
Gumdrops:	Vernell's Fruit Slices
Ham:	White's Domestic Boiled Ham
Salted Peanuts:	Planter's Cocktail Peanuts
Pretzels:	Nabisco Mister Salty Pretzel Sticks
Unsalted Crackers:	Sunshine Crispy Crackers, Unsalted Tops
Cheese:	Kraft Part-Skim Mozzarella
Unsalted Peanuts:	Planter's Unsalted Peanuts

FOOD WEIGHTS

Subject # _____

	BEFORE Food & Bowl	AFTER Food & Bowl	AMOUNT EATEN
___ 1. cheese	_____	_____	_____
___ 2. chocolate	_____	_____	_____
___ 3. coffee cake	_____	_____	_____
___ 4. crackers	_____	_____	_____
___ 5. gumdrops	_____	_____	_____
___ 6. peanuts	_____	_____	_____
___ 7. pretzels	_____	_____	_____
___ 8. ham	_____	_____	_____
___ 9. unsalted peanuts	_____	_____	_____

Order of Foods _____

[illegible]

Appendix B: Questionnaires for Human Study

Consent Form

Taste Judgment Rating Sheets

Multiple Affect Adjective Check List (MAACL)

Food Preference Rating Sheet

Beck Depression Inventory (BDI)

Eating Habits Questionnaire (Herman & Polivy)

Eating Questionnaire (Stunkard)

Symptom Checklist

Interpersonal Support Evaluation List (ISEL, Cohen)

General Questionnaire

Physical Activity Questionnaire

CONSENT FOR PARTICIPATION IN AN INVESTIGATION
UNIFORMED SERVICES UNIVERSITY OF THE HEALTH SCIENCES

Pregnancy and Sensory Sensitivity

You are invited to participate voluntarily in a research study of sensory sensitivity. We're investigating the effects of pregnancy on sensory sensitivity.

If you decide to participate, you might eat standard foods and we might test your audition (hearing) and vision. We also will measure your height and weight. After these measurements you will fill out questionnaires concerning personal preferences and habits. This study will last roughly an hour and a half. There is some information about the study we cannot give you in advance because it may affect the study. A complete explanation of the measurements made in the experiment will be given at the end of the session.

You will receive \$20 for your participation in the study. Other than the financial compensation, you will not receive any benefits from this study although your participation will contribute to our research.

The results of this study will be stored in the Department of Medical Psychology. Any information from this study will be disclosed in publication in a manner that does not reveal your identity.

Your decision whether or not to participate will not prejudice your future contacts with the Uniformed Services University of the Health Sciences or its affiliates. If you decide to participate, you are free to withdraw your consent and to discontinue participation at any time.

If you believe that you have suffered any injury or illness as the result of participating in this research, please contact the Office of Grants Management, 295-3303, at the University. This office can review the matter with you and may be able to identify resources available to you.

Feel free to ask any questions you have about the study, and we will be happy to answer them. If you have any additional questions later, don't hesitate to contact us. Please call Dr. Neil Grunberg at 295-3270 with any additional questions.

You are making a decision whether or not to participate. Your signature indicates that having read the above information, you have decided to participate.

I have received a copy of this consent form.

Date _____

Name _____

Time _____

Signature _____

Signature of Witness _____

TASTE JUDGMENTS

Extremely SWEET	1	2	3	4	5	6	7	Not at all SWEET
Extremely SOUR	1	2	3	4	5	6	7	Not at all SOUR
Extremely SALTY	1	2	3	4	5	6	7	Not at all SALTY
Extremely BITTER	1	2	3	4	5	6	7	Not at all BITTER
Extremely SPICY	1	2	3	4	5	6	7	Not at all SPICY
FLAVORFUL	1	2	3	4	5	6	7	BLAND
SMOOTH	1	2	3	4	5	6	7	GRAINY
LIGHT	1	2	3	4	5	6	7	HEAVY
STRONG	1	2	3	4	5	6	7	MILD
FRESH	1	2	3	4	5	6	7	STALE

DIRECTIONS: On the next sheet you will find words which describe different kinds of moods and feelings. Mark an X in the boxes beside the words which describe how you have felt in the last two weeks. Some of the words may sound alike, but we want you to check all the words that describe your feelings. Work rapidly.

- | | | |
|--|--|--|
| 1 <input type="checkbox"/> active | 45 <input type="checkbox"/> fit | 89 <input type="checkbox"/> peaceful |
| 2 <input type="checkbox"/> adventurous | 46 <input type="checkbox"/> forlorn | 90 <input type="checkbox"/> pleased |
| 3 <input type="checkbox"/> affectionate | 47 <input type="checkbox"/> frank | 91 <input type="checkbox"/> pleasant |
| 4 <input type="checkbox"/> afraid | 48 <input type="checkbox"/> free | 92 <input type="checkbox"/> polite |
| 5 <input type="checkbox"/> agitated | 49 <input type="checkbox"/> friendly | 93 <input type="checkbox"/> powerful |
| 6 <input type="checkbox"/> agreeable | 50 <input type="checkbox"/> frightened | 94 <input type="checkbox"/> quiet |
| 7 <input type="checkbox"/> aggressive | 51 <input type="checkbox"/> furious | 95 <input type="checkbox"/> reckless |
| 8 <input type="checkbox"/> alive | 52 <input type="checkbox"/> gay | 96 <input type="checkbox"/> rejected |
| 9 <input type="checkbox"/> alone | 53 <input type="checkbox"/> gentle | 97 <input type="checkbox"/> rough |
| 10 <input type="checkbox"/> amiable | 54 <input type="checkbox"/> glad | 98 <input type="checkbox"/> sad |
| 11 <input type="checkbox"/> amused | 55 <input type="checkbox"/> gloomy | 99 <input type="checkbox"/> safe |
| 12 <input type="checkbox"/> angry | 56 <input type="checkbox"/> good | 100 <input type="checkbox"/> satisfied |
| 13 <input type="checkbox"/> annoyed | 57 <input type="checkbox"/> good-natured | 101 <input type="checkbox"/> secure |
| 14 <input type="checkbox"/> awful | 58 <input type="checkbox"/> grim | 102 <input type="checkbox"/> shaky |
| 15 <input type="checkbox"/> bashful | 59 <input type="checkbox"/> happy | 103 <input type="checkbox"/> shy |
| 16 <input type="checkbox"/> bitter | 60 <input type="checkbox"/> healthy | 104 <input type="checkbox"/> soothed |
| 17 <input type="checkbox"/> blue | 61 <input type="checkbox"/> hopeless | 105 <input type="checkbox"/> steady |
| 18 <input type="checkbox"/> bored | 62 <input type="checkbox"/> hostile | 106 <input type="checkbox"/> stubborn |
| 19 <input type="checkbox"/> calm | 63 <input type="checkbox"/> impatient | 107 <input type="checkbox"/> stormy |
| 20 <input type="checkbox"/> cautious | 64 <input type="checkbox"/> incensed | 108 <input type="checkbox"/> strong |
| 21 <input type="checkbox"/> cheerful | 65 <input type="checkbox"/> indignant | 109 <input type="checkbox"/> suffering |
| 22 <input type="checkbox"/> clean | 66 <input type="checkbox"/> inspired | 110 <input type="checkbox"/> sullen |
| 23 <input type="checkbox"/> complaining | 67 <input type="checkbox"/> interested | 111 <input type="checkbox"/> sunk |
| 24 <input type="checkbox"/> contented | 68 <input type="checkbox"/> irritated | 112 <input type="checkbox"/> sympathetic |
| 25 <input type="checkbox"/> contrary | 69 <input type="checkbox"/> jealous | 113 <input type="checkbox"/> tame |
| 26 <input type="checkbox"/> cool | 70 <input type="checkbox"/> joyful | 114 <input type="checkbox"/> tender |
| 27 <input type="checkbox"/> cooperative | 71 <input type="checkbox"/> kindly | 115 <input type="checkbox"/> tense |
| 28 <input type="checkbox"/> critical | 72 <input type="checkbox"/> lonely | 116 <input type="checkbox"/> terrible |
| 29 <input type="checkbox"/> cross | 73 <input type="checkbox"/> lost | 117 <input type="checkbox"/> terrified |
| 30 <input type="checkbox"/> cruel | 74 <input type="checkbox"/> loving | 118 <input type="checkbox"/> thoughtful |
| 31 <input type="checkbox"/> daring | 75 <input type="checkbox"/> low | 119 <input type="checkbox"/> timid |
| 32 <input type="checkbox"/> desperate | 76 <input type="checkbox"/> lucky | 120 <input type="checkbox"/> tormented |
| 33 <input type="checkbox"/> destroyed | 77 <input type="checkbox"/> mad | 121 <input type="checkbox"/> understanding |
| 34 <input type="checkbox"/> devoted | 78 <input type="checkbox"/> mean | 122 <input type="checkbox"/> unhappy |
| 35 <input type="checkbox"/> disagreeable | 79 <input type="checkbox"/> meek | 123 <input type="checkbox"/> unsociable |
| 36 <input type="checkbox"/> discontented | 80 <input type="checkbox"/> merry | 124 <input type="checkbox"/> upset |
| 37 <input type="checkbox"/> discouraged | 81 <input type="checkbox"/> mild | 125 <input type="checkbox"/> vexed |
| 38 <input type="checkbox"/> disgusted | 82 <input type="checkbox"/> miserable | 126 <input type="checkbox"/> warm |
| 39 <input type="checkbox"/> displeased | 83 <input type="checkbox"/> nervous | 127 <input type="checkbox"/> whole |
| 40 <input type="checkbox"/> energetic | 84 <input type="checkbox"/> obliging | 128 <input type="checkbox"/> wild |
| 41 <input type="checkbox"/> enraged | 85 <input type="checkbox"/> offended | 129 <input type="checkbox"/> willful |
| 42 <input type="checkbox"/> enthusiastic | 86 <input type="checkbox"/> outraged | 130 <input type="checkbox"/> wilted |
| 43 <input type="checkbox"/> fearful | 87 <input type="checkbox"/> panicky | 131 <input type="checkbox"/> worrying |
| 44 <input type="checkbox"/> fine | 88 <input type="checkbox"/> patient | 132 <input type="checkbox"/> young |

FOOD PREFERENCES

Please rate the foods which you have tasted for how much you liked them today.

1. UNSALTED CRACKERS:	Very Much	1	2	3	4	5	6	7	Very Little
2. CHEESE:	Very Much	1	2	3	4	5	6	7	Very Little
3. CHOCOLATE:	Very Much	1	2	3	4	5	6	7	Very Little
4. COFFEE CAKE:	Very Much	1	2	3	4	5	6	7	Very Little
5. GUMDROPS:	Very Much	1	2	3	4	5	6	7	Very Little
6. HAM:	Very Much	1	2	3	4	5	6	7	Very Little
7. SALTED PEANUTS:	Very Much	1	2	3	4	5	6	7	Very Little
8. PRETZELS:	Very Much	1	2	3	4	5	6	7	Very Little
9. UNSALTED PEANUTS:	Very Much	1	2	3	4	5	6	7	Very Little

Please rate the foods which you tasted for how much you usually like them.

1. UNSALTED CRACKERS:	Very Much	1	2	3	4	5	6	7	Very Little
2. CHEESE:	Very Much	1	2	3	4	5	6	7	Very Little
3. CHOCOLATE:	Very Much	1	2	3	4	5	6	7	Very Little
4. COFFEE CAKE:	Very Much	1	2	3	4	5	6	7	Very Little
5. GUMDROPS:	Very Much	1	2	3	4	5	6	7	Very Little
6. HAM:	Very Much	1	2	3	4	5	6	7	Very Little
7. SALTED PEANUTS:	Very Much	1	2	3	4	5	6	7	Very Little
8. PRETZELS:	Very Much	1	2	3	4	5	6	7	Very Little
9. UNSALTED PEANUTS	Very Much	1	2	3	4	5	6	7	Very Little

STATE ASSESSMENT INVENTORY
INSTRUCTIONS

The following questionnaire is designed to measure your feelings about yourself and your situation at the present time.

There are twenty-one groups of statements, each group designated by a letter, A - U. In each group of statements you will be asked to make a check mark beside the one statement which most accurately reflects your feelings at the present time.

STATE ASSESSMENT INVENTORY

A

- ☐ I do not feel sad
- ☐ I feel blue or sad
- ☐ I am blue or sad all the time and I can't snap out of it
- ☐ I am so sad or unhappy that it is very painful
- ☐ I am so sad or unhappy that I can't stand it

B

- ☐ I am not particularly pessimistic or discouraged about the future
- ☐ I feel discouraged about the future
- ☐ I feel I have nothing to look forward to
- ☐ I feel that I won't ever get over my troubles
- ☐ I feel that the future is hopeless and that things cannot improve

C

- ☐ I do not feel like a failure
- ☐ I feel I have failed more than the average person
- ☐ I feel I have accomplished very little that is worthwhile or that means anything
- ☐ As I look back on my life all I can see is a lot of failures
- ☐ I feel I am a complete failure as a person (parent, husband, wife)

D

- ☐ I am not particularly dissatisfied
- ☐ I feel bored most of the time
- ☐ I don't enjoy things the way I used to
- ☐ I don't get satisfaction out of anything any more
- ☐ I am dissatisfied with everything

E

- ☐ I don't feel particularly guilty
- ☐ I feel bad or unworthy a good part of the time
- ☐ I feel quite guilty
- ☐ I feel bad or unworthy practically all the time now
- ☐ I feel as though I am very bad or worthless

F

- ☐ I don't feel I am being punished
- ☐ I have a feeling that something bad may happen to me
- ☐ I feel I am being punished or will be punished
- ☐ I feel I deserve to be punished
- ☐ I want to be punished

G

☐ I don't feel disappointed in myself
☐ I am disappointed in myself
☐ I don't like myself
☐ I am disgusted with myself
☐ I hate myself

H

☐ I don't feel I am any worse than anybody else
☐ I am very critical of myself for my weaknesses or mistakes
☐ I blame myself for everything that goes wrong
☐ I feel I have many bad faults

I

☐ I don't have any thoughts of harming myself
☐ I have thoughts of harming myself but I would not carry them out
☐ I feel I would be better off dead
☐ I have definite plans about committing suicide
☐ I feel my family would be better off if I were dead
☐ I would kill myself if I could

J

☐ I don't cry any more than usual
☐ I cry more now than I used to
☐ I cry all the time now. I can't stop it
☐ I used to be able to cry but now I can't cry at all even though I want to

K

☐ I am no more irritated now than I ever am
☐ I get annoyed or irritated more easily than I used to
☐ I feel irritated all the time
☐ I don't get irritated at all at the things that used to irritate me

L

☐ I have not lost interest in other people
☐ I am less interested in other people now than I used to be
☐ I have lost most of my interest in other people and have little feeling for them
☐ I have lost all my interest in other people and don't care about them at all

M

☐ I make decisions about as well as ever
☐ I am less sure of myself now and try to put off making decisions
☐ I can't make decisions any more without help
☐ I can't make any decisions at all any more

N

☐ I don't feel I look any worse than I used to
☐ I am worried that I am looking old or unattractive
☐ I feel that there are permanent changes in my appearance and they make me look unattractive
☐ I feel that I am ugly or repulsive looking

-3-

O

- ☐ I can work about as well as before
- ☐ It takes extra effort to get started at doing something
- ☐ I don't work as well as I used to
- ☐ I have to push myself very hard to do anything
- ☐ I can't do any work at all

P

- ☐ I can sleep as well as usual
- ☐ I wake up more tired in the morning than I used to
- ☐ I wake up 1-2 hours earlier than usual and find it hard to get back to sleep
- ☐ I wake up early every day and can't get more than 5 hours sleep

Q

- ☐ I don't get any more tired than usual
- ☐ I get tired more easily than I used to
- ☐ I get tired from doing anything
- ☐ I get too tired to do anything

R

- ☐ My appetite is no worse than usual
- ☐ My appetite is not as good as it used to be
- ☐ My appetite is much worse now
- ☐ I have no appetite at all any more

S

- ☐ I haven't lost much weight, if any, lately
- ☐ I have lost more than 5 pounds
- ☐ I have lost more than 10 pounds
- ☐ I have lost more than 15 pounds

T

- ☐ I am no more concerned about my health than usual
- ☐ I am concerned about aches and pains or upset stomach or constipation or other unpleasant feelings in my body
- ☐ I am so concerned with how I feel or what I feel that it's hard to think of much else
- ☐ I am completely absorbed in what I feel

U

- ☐ I have not noticed any recent change in my interest in sex
- ☐ I am less interested in sex than I used to be
- ☐ I am much less interested in sex now
- ☐ I have lost interest in sex completely

DIRECTIONS: The questions on the next five pages refer to your eating pattern and weight fluctuations before you became pregnant. Think back to the time when you were not pregnant and answer the questions accordingly.

BEFORE YOU BECAME PREGNANT:

EATING HABITS QUESTIONNAIRE

1. How often did you diet? (Circle one)
 Never Rarely Sometimes Usually Always
2. What was the maximum amount of weight (in pounds) you had ever lost within one month? (Circle one)
 0-4 5-9 10-14 15-19 20
3. What was your maximum weight gain within a week? (Circle one)
 0-1 1.1-2 2.1-3 3.1-5 5.1
4. In a typical week, how much did your weight fluctuate? (Circle one)
 0-1 1.1-2 2.1-3 3.1-5 5.1
5. Would a weight fluctuation of 5 lbs. have affected the way you live your life? (Circle one)
 Not at all Slightly Moderately Very much
6. Did you eat sensibly in front of others and splurge alone? (Circle one)
 Never Rarely Often Always
7. Did you give too much time and thought to food? (Circle one)
 Never Rarely Often Always
8. Did you have feelings of guilt after overeating? (Circle one)
 Never Rarely Often Always
9. How conscious were you of what you're eating? (Circle one)
 Not at all Slightly Moderately Extremely
10. What was your maximum weight ever? _____
11. How many pounds over your desired weight were you at your maximum weight? (Circle one)
 0-1 1-5 6-10 11-20 21

Eating Questionnaire

1. I ate anything I wanted, any time I wanted. T F
2. While on a diet, if I ate a food that was not allowed, I often then splurged and ate other high calorie foods. T F
3. I often felt so hungry that I just had to eat something. T F
4. To what extent did this statement describe your eating behavior?
 "I start dieting in the morning, but because of any number of things that happen during the day, by evening I have given up and eat what I want, promising myself to start dieting again tomorrow."

1	2	3	4
not	little	pretty good	describes
like me	like me	description of me	me perfectly

5. I got so hungry that my stomach often seemed like a bottomless pit. T F
6. I consciously held back at meals in order to not gain weight. T F
7. How many pounds over your desired weight were you at your maximum weight?

0	1	2	3	4	5	6	7	8	9
zero	less	less	less	less	less	less	less	less	greater
lbs	than	than	than	than	than	than	than	than	than
	5 lbs	10 lbs	15 lbs	20 lbs	35 lbs	50 lbs	75 lbs	150 lbs	150 lbs

8. On a scale of 0 to 10, where 0 means no restraint in eating (eat whatever you want, whenever you want) and 10 means total restraint (constantly limiting food intake and never "giving in"), what number would you have given yourself?

0	eat whatever you want, whenever you want it
1	
2	usually eat whatever you want, whenever you want it
3	
4	often eat whatever you want, whenever you want it
5	
6	often limit food intake, but often "give in"
7	
8	usually limit food intake, rarely "give in"
9	
10	constantly limiting food intake, never "giving in"

9. Dieting was so hard for me because I just got too hungry. T F

10. How likely were you to shop for low calorie foods?

1	2	3	4
unlikely	slightly likely	moderately likely	very likely

11. Did you eat sensibly in front of others and splurge alone?

1	2	3	4
never	rarely	often	always

12. How often did you feel hungry?

1	2	3	4
only at meal times	sometimes between meals	often between meals	almost always

13. Did you go on eating binges even though you were not hungry?

1	2	3	4
never	rarely	sometimes	at least once a week

14. I did not eat some foods because they made me fat. T F

15. When I was with someone who was overeating, I usually overate, too. T F

16. I counted calories as a conscious means of controlling my weight. T F

17. When I felt lonely, I consoled myself by eating. T F

18. I was always hungry so it was hard for me to stop eating before I finish the food on my plate. T F

19. I deliberately took small helpings as a means of controlling my weight. T F

20. What was your maximum weight gain within a week?

0	1	2	3	4	5	6	7	8	9
zero	less	less	less	less	less	less	less	less	greater
lbs	than	than	than	than	than	than	than	than	than
	1 lb	2 lbs	3 lbs	4 lbs	5 lbs	6 lbs	7 lbs	9 lbs	9 lbs

21. How often were you dieting in a conscious effort to control your weight?

1	2	3	4
rarely	sometimes	usually	always

22. How likely were you to consciously eat less than you wanted?

1	2	3	4
unlikely	slightly likely	moderately likely	very likely

23. My weight had hardly changed at all in the last ten years. T F
24. I was usually so hungry that I ate more than three times a day. T F
25. Being with someone who is eating often made me hungry enough to eat also. T F
26. When I felt blue, I often overate. T F
27. Did feelings of guilt about overeating help you to control your food intake?

1	2	3	4
never	rarely	often	always

28. It was not difficult for me to leave something on my plate. T F
29. I often stopped eating when I was not really full as a conscious means of limiting the amount that I ate. T F
30. How likely were you to consciously eat slowly in order to cut down on how much you ate? T F
31. When I felt anxious, I found myself eating. T F
32. How difficult would it have been for you to stop eating half-way through dinner and not eat for the next four hours?

1	2	3	4
easy	slightly difficult	moderately difficult	very difficult

33. Since I was often hungry, I sometimes wished that while I was eating an expert would tell me that I had had enough or that I could have had something more to eat. T F
34. I had a pretty good idea of the number of calories in common foods. T F
35. I was always hungry enough to eat at any time. T F
36. I enjoyed eating too much to spoil it by my counting calories or by watching my weight. T F
37. What was your maximum weight loss within one month?

1	2	3	4	5	6	7	8	9	10
less than 2 lb	less than 4 lbs	less than 6 lbs	less than 8 lbs	less than 10 lbs	less than 12 lbs	less than 15 lbs	less than 20 lbs	less than 30 lbs	greater than 30 lbs

38. Sometimes when I started eating I just couldn't seem to stop. T F
39. When I saw a real delicacy, I often got so hungry that I had to eat it right away. T F

40. While on a diet, if I ate a food that was not allowed, I consciously ate less for a period of time to make up for it. T F
41. I paid a great deal of attention to changes in my figure. T F
42. I usually ate too much at social occasions like parties and picnics. T F
43. When I had eaten my quota of calories, I was usually good about not eating any more. T F
44. Life is too short to worry about dieting. T F
45. In a typical week, how much did your weight fluctuate (maximum-minimum)?
- | | | | | | | |
|------|------|-------|-------|-------|-------|---------|
| 0 | 1 | 2 | 3 | 4 | 5 | 6 |
| zero | less | less | less | less | less | greater |
| lbs | than | than | than | than | than | than |
| | 1 lb | 2 lbs | 3 lbs | 4 lbs | 5 lbs | 5 lbs |
46. Since my weight went up and down, I went on reducing diets more than once. T F
47. Would a weight fluctuation of 5 lbs have affected the way you live your life?
- | | | | |
|------------|----------|------------|-----------|
| 1 | 2 | 3 | 4 |
| not at all | slightly | moderately | very much |
48. Without even thinking about it, I took a long time to eat. T F
49. I sometimes got very hungry late in the evening or at night. T F
50. At certain times of the day I got hungry because I had gotten used to eating then. T F
51. How conscious were you of what you were eating?
- | | | | |
|------------|----------|------------|-----------|
| 1 | 2 | 3 | 4 |
| not at all | slightly | moderately | very much |
52. Sometimes things just tasted so good that I kept on eating even when I was no longer hungry. T F
53. How frequently did you skip dessert because you were no longer hungry?
- | | | | |
|--------|--------|-------------|----------|
| 1 | 2 | 3 | 4 |
| almost | | at least | almost |
| never | seldom | once a week | everyday |
54. How frequently did you avoid "stocking up" on tempting foods?
- | | | | |
|--------------|--------|---------|---------------|
| 1 | 2 | 3 | 4 |
| almost never | seldom | usually | almost always |

SYMPTOM CHECKLIST

To what extent are you experiencing the following feelings or symptoms today? (Circle one)

lethargy	not at all	1	2	3	4	5	6	7	extremely
irritability	not at all	1	2	3	4	5	6	7	extremely
bloating	not at all	1	2	3	4	5	6	7	extremely
headache	not at all	1	2	3	4	5	6	7	extremely
menstrual cramps	not at all	1	2	3	4	5	6	7	extremely
breast tenderness	not at all	1	2	3	4	5	6	7	extremely
crying spells	not at all	1	2	3	4	5	6	7	extremely
altered sexual feelings	not at all	1	2	3	4	5	6	7	extremely

Interpersonal Support Evaluation List

Instructions

This scale is made up of a list of statements each of which may or may not be true about you RIGHT NOW in your life. For each statement we would like you to circle probably TRUE (T) if the statement is true about you or probably FALSE (F) if the statement is not true about you.

You may find that many of the statements are neither clearly true nor clearly false. In these cases, try to decide quickly whether probably TRUE (T) or probably FALSE (F) is most descriptive of you. Although some questions will be difficult to answer, it is important that you pick one alternative or the other. Remember to circle only one of the alternatives for each statement.

Please read each item quickly but carefully before responding. Remember that this is not a test and there are no right or wrong answers.

- T F 1. There is at least one person I know whose advice I really trust.
- T F 2. If I decide on Friday afternoon that I would like to go to a movie that evening, I could find someone to go with me.
- T F 3. If for some reason I were put in jail, there is someone I could call who would bail me out.
- T F 4. In general, people don't have much confidence in me.
- T F 5. No one I know would throw a birthday party for me.
- T F 6. If I had to go out of town for a few weeks, someone I know would look after my home (the plants, pets, yard, etc.).
- T F 7. I have someone who takes pride in my accomplishments.
- T F 8. There is really no one I can trust to give me good financial advice.
- T F 9. If I were sick and needed someone to drive me to the doctor, I would have trouble finding someone.
- T F 10. Most of my friends are more successful at making changes in their lives than I am.
- T F 11. There is really no one who can give me objective feedback about how I'm handling my problems.
- T F 12. There are several different people with whom I enjoy spending time.
- T F 13. Most people I know think highly of me.
- T F 14. When I need suggestions for how to deal with a personal problem I know there is someone I can turn to.
- T F 15. I don't often get invited to do things with others.
- T F 16. There is no one I could call on if I needed to borrow a car for a few hours.
- T F 17. There is someone who I feel comfortable going to for advice about sexual problems.
- T F 18. If I wanted to have lunch with someone, I could easily find someone to join me.
- T F 19. If I needed a quick emergency loan of \$100, there is someone I could get it from.
- T F 20. Most of my friends are more interesting than I am.

- T F 21. I am able to do things as well as most other people.
- T F 22. If I needed a ride to the airport very early in the morning, I would have a hard time finding anyone to take me.
- T F 23. If I wanted to go out of town (e.g., to the beach) for the day I would have a hard time finding someone to go with me.
- T F 24. There is someone I could turn to for advice about changing my job or finding a new one.
- T F 25. If I had to mail an important letter at the post office by 5:00 and couldn't make it, there is someone who could do it for me.
- T F 26. I feel that I'm on the fringe in my circle of friends.
- T F 27. There are very few people I trust to help solve my problems.
- T F 28. I am closer to my friends than most other people.
- T F 29. I regularly meet or talk with members of my family or friends.
- T F 30. If a family crisis arose few of my friends would be able to give me good advice about handling it.
- T F 31. I think that my friends feel that I'm not very good at helping them solve problems.
- T F 32. If I got stranded 10 miles out of town, there is someone I could call to come get me.
- T F 33. I feel that there is no one with whom I can share my most private worries and fears.
- T F 34. I have a hard time keeping pace with my friends.
- T F 35. If I were sick, there would be almost no one I could find to help me with my daily chores.
- T F 36. When I feel lonely, there are several people I could call and talk to.
- T F 37. There is someone I can turn to for advice about handling hassles over household responsibilities.
- T F 38. I am more satisfied with my life than most people are with theirs.
- T F 39. If I needed some help in moving to a new home, I would have a hard time finding someone to help me.
- T F 40. Most people I know don't enjoy the same things that I do.

General Questionnaire

This questionnaire will examine some of your everyday habits and behaviors. It will also assess your weight and obstetric history and ask some questions about your pregnancy. There are three kinds of questions in this questionnaire.

One type asks a question and gives you choices. For example:

Do you smoke? Yes No

You should circle either Yes or No to answer this question.

A second type will ask a question and leave a blank for your response. For example:

How old are you? _____

Please write your answer in the blank.

A third type asks a question and then provides seven numbers to represent a range of reactions. You are to circle one of the numbers to describe yourself. For example:

How pleasant do you feel?

not at all	1	2	3	4	5	6	7	extremely
pleasant								pleasant

Circle the number between 1 and 7 that most closely corresponds to your answer.

General Information

1. Are you working outside the home? Yes No
If yes, answer a-c. If no, go to 2.
 - a. What is your occupation? _____
 - b. What is your annual salary?
less than \$10,000 \$10,000-\$30,000 \$30,000-\$50,000 over \$50,000
 - c. Do you generally enjoy your work? Yes No

2. Have you ever worked outside the home? Yes No
If yes, answer a-c. If no, go to 3.
 - a. What was your most recent occupation? _____
 - b. What was your last annual salary? _____
 - c. Did you generally enjoy your work? Yes No

3. Do you have any leisure activities or hobbies? Yes No
If yes, what are they? _____

4. Are you now living with a spouse or an equivalent? Yes No
If yes, answer a-e. If no, please go to question #4.
 - a. What is your spouse/equivalent's occupation?

 - b. Does your spouse/equivalent generally enjoy this occupation? Yes No
 - c. What is your spouse/equivalent's annual salary? _____
 - d. For how many years have you been living with this spouse/equivalent?
_____ years
 - e. How would you describe your relationship?

extremely	1	2	3	4	5	6	7	not at all
happy								happy

5. Are you experiencing any unusual stressors (e.g., illness, car accident) today that might effect the way you behaved in the study? If so, please describe _____

6. What did you eat today for breakfast? _____

7. What did you eat today for lunch? _____

8. What snacks did you eat today? _____

9. Because of this pregnancy, are you consciously eating more? Yes No
10. Because of this pregnancy, do you give too much time and thought to food? (Circle one)
Never Rarely Often Always
11. Because of this pregnancy, do you eat sensibly in front of others and splurge alone? (Circle one)
Never Rarely Often Always
12. Because of this pregnancy, are you consciously exercising more? (Circle one)
Never Rarely Often Always
13. Because of this pregnancy, are you avoiding certain foods? Yes No
If yes, what are they? _____

14. Because of this pregnancy, are you consuming more of certain foods?
Yes No If yes, what are they? _____

15. Because of this pregnancy, have you made lifestyle modifications other than eating and exercise? Yes No
If yes, what are they? _____

16. In general how hungry have you been in the last two weeks?
- | | | | | | | |
|------------|---|---|------------|---|---|-----------|
| 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| Not at all | | | Moderately | | | Extremely |
| hungry | | | hungry | | | hungry |
17. Have you ever had an abortion or a miscarriage? Yes No
If so, please describe?
- | | | |
|------------|------------|-----------------------|
| What _____ | When _____ | Which trimester _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |
| _____ | _____ | _____ |
18. What is your religion? _____

11. Have you experienced any cravings for specific food or types of foods during this pregnancy?
If yes, please list.

a. Food		When? (Circle one)		1st trimester		2nd trimester		3rd trimester		Postpartum	
How intense was this craving?											
not at all		1	2	3	4	5	6	7	extremely intense		
intense											

b. Food		When? (Circle one)		1st trimester		2nd trimester		3rd trimester		Postpartum	
How intense was this craving?											
not at all	1	2	3	4	5	6	7			extremely	
intense										intense	

c.	<u>Food</u>								
	When? (Circle one)		1st	2nd	3rd				Postpartum
			trimester	trimester	trimester				
	How intense was this craving?								
	not at all	1	2	3	4	5	6	7	extremely
	intense								intense

[illegible]

e. Food		When? (Circle one)		1st trimester		2nd trimester		3rd trimester		Postpartum
How intense was this craving?										
not at all	1	2	3	4	5	6	7			extremely intense
intense										

f. Food		When? (Circle one)		1st trimester		2nd trimester		3rd trimester		Postpartum
How intense was this craving?										
not at all	1	2	3	4	5	6	7			extremely
intense										intense

12. Have you experienced any aversions (extreme dislike) to specific foods or types of foods during this pregnancy? Yes No
If yes, please list.

a. Food

When? (Circle one)	1st trimester				2nd trimester		3rd trimester		Postpartum
How intense was this aversion?									
not at all	1	2	3	4	5	6	7		extremely intense

b. Food

When? (Circle one)	1st trimester				2nd trimester		3rd trimester		Postpartum
How intense was this aversion?									
not at all	1	2	3	4	5	6	7		extremely intense

c. Food

When? (Circle one)	1st trimester				2nd trimester		3rd trimester		Postpartum
How intense was this aversion?									
not at all	1	2	3	4	5	6	7		extremely intense

d. Food

When? (Circle one)	1st trimester				2nd trimester		3rd trimester		Postpartum
How intense was this aversion?									
not at all	1	2	3	4	5	6	7		extremely intense

e. Food

When? (Circle one)	1st trimester				2nd trimester		3rd trimester		Postpartum
How intense was this aversion?									
not at all	1	2	3	4	5	6	7		extremely intense

f. Food

When? (Circle one)	1st trimester				2nd trimester		3rd trimester		Postpartum
How intense was this aversion?									
not at all	1	2	3	4	5	6	7		extremely intense

Previous Pregnancies

1. Is this your first pregnancy? Yes No
 If no, please list other pregnancies, starting with the most recent.

Pregnancy # _____ Male or Female Child? M F
 How would you describe that pregnancy?
 very easy 1 2 3 4 5 6 7 very difficult
 How much weight did you gain during that pregnancy? _____ lbs.
 Did you lose this weight immediately after delivery? Yes No

Pregnancy # _____ Male or Female Child? M F
 How would you describe that pregnancy?
 very easy 1 2 3 4 5 6 7 very difficult
 How much weight did you gain during that pregnancy? _____ lbs.
 Did you lose this weight immediately after delivery? Yes No

Pregnancy # _____ Male or Female Child? M F
 How would you describe that pregnancy?
 very easy 1 2 3 4 5 6 7 very difficult
 How much weight did you gain during that pregnancy? _____ lbs.
 Did you lose this weight immediately after delivery? Yes No

Pregnancy # _____ Male or Female Child? M F
 How would you describe that pregnancy?
 very easy 1 2 3 4 5 6 7 very difficult
 How much weight did you gain during that pregnancy? _____ lbs.
 Did you lose this weight immediately after delivery? Yes No

Pregnancy # _____ Male or Female Child? M F
 How would you describe that pregnancy?
 very easy 1 2 3 4 5 6 7 very difficult
 How much weight did you gain during that pregnancy? _____ lbs.
 Did you lose this weight immediately after delivery? Yes No

Pregnancy # _____ Male or Female Child? M F
 How would you describe that pregnancy?
 very easy 1 2 3 4 5 6 7 very difficult
 How much weight did you gain during that pregnancy? _____ lbs.
 Did you lose this weight immediately after delivery? Yes No

Weight History

1a. How much did you weigh at the age of 10? _____ lbs.

b. How underweight or overweight were you at 10 years?
 very 1 2 3 4 5 6 7 very
 underweight overweight

c. How satisfied were you with your weight at 10 years?
 not at all 1 2 3 4 5 6 7 very much

d. At that time were you consciously trying to diet?
 not at all 1 2 3 4 5 6 7 very much

2a. How much did you weigh at the age of 15? _____ lbs.

b. How much underweight or overweight were you at 15 years?
 very 1 2 3 4 5 6 7 very
 underweight overweight

c. How satisfied were with your weight at 15 years?
 not at all 1 2 3 4 5 6 7 very much

d. At this time were you consciously trying to diet?
 not at all 1 2 3 4 5 6 7 very much

3a. How much did you weigh at the age of 20? _____ lbs.

b. How underweight or overweight were you at 20 years?
 very 1 2 3 4 5 6 7 very
 underweight overweight

c. How satisfied were with your weight at 20 years?
 not at all 1 2 3 4 5 6 7 very much

d. At that time were you consciously trying to diet?
 not at all 1 2 3 4 5 6 7 very much

4a. How much did you weigh at the age of 30? _____ lbs.

b. How underweight or overweight were you at 30 years?
 very 1 2 3 4 5 6 7 very
 underweight overweight

c. How satisfied were you with your weight at 30 years?
 not at all 1 2 3 4 5 6 7 very much

d. At that time were you consciously trying to diet?
 not at all 1 2 3 4 5 6 7 very much

5a. How much did you weigh at the age of 40? _____ lbs.

b. How underweight or overweight were you at 40 years?
 very 1 2 3 4 5 6 7 very
 underweight overweight

c. How satisfied were you with your weight at 40 years?
 not at all 1 2 3 4 5 6 7 very much

d. At that time were consciously trying to diet?
 not at all 1 2 3 4 5 6 7 very much

6a. How much did you weigh just before this pregnancy? _____ lbs.

b. How underweight or overweight were you?
 very 1 2 3 4 5 6 7 very
 underweight overweight

c. How satisfied were you with your weight?
 not at all 1 2 3 4 5 6 7 very much

d. At this time were you consciously on a diet?
 not at all 1 2 3 4 5 6 7 very much

7. In general, how much underweight or overweight have you been throughout your life?
 very 1 2 3 4 5 6 7 very
 underweight overweight

8. How much has your weight fluctuated during your nonpregnant adult life?
 weight remained 1 2 3 4 5 6 7 weight widely
 stable fluctuated

9. In general, how underweight or overweight was your biological father when you were growing up?
 very 1 2 3 4 5 6 7 very
 underweight overweight

10. In general, how underweight or overweight was your biological mother when you were growing up?
 very 1 2 3 4 5 6 7 very
 underweight overweight

11. In general, how underweight or overweight were your siblings when you were growing up?
 very 1 2 3 4 5 6 7 very
 underweight overweight

12. In general, how underweight or overweight is your spouse/equivalent?
 very 1 2 3 4 5 6 7 very
 underweight overweight

13. In general, how underweight or overweight are your children?
 very 1 2 3 4 5 6 7 very
 underweight overweight

very underweight	1	2	3	4	5	6	7	very overweight
---------------------	---	---	---	---	---	---	---	--------------------

underweight very
overweight

14. Does anyone in your family, including you, have any dietary restrictions (e.g., vegetarian, salt-free, etc.)? Yes No
If yes, please list who (e.g., you, your child, etc.) and describe.

If yes, please list who (e.g., you, your child, etc.) and describe.

15. Does anyone in your family, including you, have any unusual eating habits (e.g., binge eating, anorexia)? Yes No

If yes, please list who and describe.

Supplementary Questions for Women

1. What was the date of the first day of your last menstrual period? _____
2. On what day do you expect your next period to start? _____
3. Do your periods come regularly? (Circle one) Yes No

If yes, a. approximately how many days does your period last? _____

b. How many days does your cycle, last, from beginning of one period to the next?

4. At any time during a normal month do you regularly experience any symptoms, such as weight gain, irritability, cramps, etc. (Circle one) Yes No

If "yes":

When

What Symptoms

- | | |
|----------|----------|
| 1. _____ | 1. _____ |
| 2. _____ | 2. _____ |
| 3. _____ | 3. _____ |

5. Do you experience a preference for any foods or tastes any time during your monthly cycle? (Circle One) Yes No

If yes:

When

Which foods or tastes

- | | |
|----------|----------|
| 1. _____ | 1. _____ |
| 2. _____ | 2. _____ |
| 3. _____ | 3. _____ |

Based on what you've learned from reading and from your obstetrician, what advice would you give to a pregnant woman concerning changes in her habits and daily living?

1. Would you tell her to eat more than before her pregnancy? Yes No

2. Would you tell her to exercise more? Yes No

3. Would you tell her to eat more of certain foods? Yes No
If yes, what are they? _____

4. Would you tell her to avoid certain foods? Yes No
If yes, what are they? _____

5. Would you tell her to sleep more? Yes No

6. Would you tell her to quit smoking? Yes No

7. Would you tell her not to drink? Yes No

8. Would you tell her to avoid certain activities? Yes No
If yes, what are they? _____

Physical Activity Questionnaire

1. How many flights of stairs do you climb up per day? (10 steps=1 flight) _____ flights

2. How many city blocks do you walk per day? (1 mile=12 blocks) _____ blocks

3. What sports or recreation have you participated in during the past week?

a. _____

How intensely?

Not very

Somewhat

Moderately

Extremely

b. _____

How intensely?

Not very

Somewhat

Moderately

Extremely

c. _____

How intensely?

Not very

Somewhat

Moderately

Extremely

4. How many times per week do you engage in any regular sports or recreational activity with sufficient intensity to work up a sweat? _____ times

5. Would you say that there has been a change in your physical activity since before your pregnancy? Yes No

If yes, what has changed?

a. _____

Increased

Decreased

b. _____

Increased

Decreased

c. _____

Increased

Decreased

d. _____

Increased

Decreased

e. _____

Increased

Decreased

6. If you work how many hours per day are spent in your occupation doing:

Vigorous Activity (working up a sweat) _____ hours

Moderate Activity (increasing breathing, not sweating) _____ hours

Light Activity (sitting, driving, slowly walking) _____ hours

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